THE

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STREET LIGHTING BY MODERN ELECTRIC LAMPS.

THE valuable paper upon the above subject recently contributed by Mr. Haydn T. Harrison, and discussed at the Institution of Electrical Engineers, should be distributed among all local authorities where a public supply of electricity is available.

It is calculated to strengthen the hands of the suppliers of electricity, although its appeal to them is in the nature of convincing the converted, whereas its practical value would be enhanced if the statements were brought home to the street-lighting authorities and impressed especially upon the inhabitants of every town.

The great importance of thoroughly well lighting the public thoroughfares must be patent to all; it secures for the residents all the advantages of daylight, besides protection against robbery and street outrages, which are facilitated by darkness. All this is becoming recognised, and the real question for settlement is the best method of illumination in relation to effectiveness and cost.

In the year 1690 an important street in the City of London, viz., Cornhill, was lighted by tallow candles placed in horn lanterns, and even at the present day oil lamps for outdoor lighting may be seen in country districts and many small railway stations, but the choice of illumination is now almost wholly limited to gas or electricity; the competition is severe, but is rapidly developing in favour of the "up-to-date" system.

The gas interest naturally fights very hard for the retention of so important a branch of its business, and has the great advantage of being in possession. It has improved the efficiency of the burners, and reduced costs, where there is competition, even beyond the margin for making any profit; but, nevertheless, electricity makes steady progress in supplanting the less efficient system, notwithstanding the fact that in most cases the gas undertakings have mains laid in every street, whereas the electric distributors are at present limited to parts only of the public thoroughfares.

An interesting instance of the progress of street-lighting competition between electricity and gas has just arisen on the Isle of Sheppey, where contracts are in progress of settlement for illuminating the streets of Sheerness and Queenborough.

The price of gas for domestic purposes is very high—viz., 3s. 6d. per 1,000, with a rebate of 4d. per 1,000 for payment within a month of delivery of the quarterly bill.

The Electric Supply Co., with its up-to-date plant of Diesel engines, &c., is able to supply consumers on terms which compare favourably in first cost with gas, apart altogether from the indirect economies incidental to electric lighting; thus, in the matter of street lighting, the company has

been able to offer a better illumination for less money than the gas company, and has secured a contract for five years.

During the progress of the negotiations the managing engineer of the Sheerness and District Electric Power and Traction Co., Ltd., carried out some important photometrical tests of the relative candle-power of the gas and electric lamps, which may be added to Mr. Harrison's paper as valuable supplementary data.

According to the report of the Works Committee, presented to the Sheerness Urban District Council, the offer of the Electric Supply Co. involved a total saving of £1 0s. 4d. per lamp per annum, amounting on a five years' contract to £381 5s. for converting 75 lamps from gas to electric lighting.

This result is important in itself, but the tests of candle-power are of even greater interest, and should be studied by everyone concerned with the question.

Experimental electric lamps appear to have been put up on the Marine Parade, to be tested against the existing gas burners, which the gas company declared to be of 80 C.P., the metallic-filament electric lamps being rated at 50 C.P.

According to the local paper, "People have been visiting Marine Parade to see for themselves which is the better light . . . . and have come away doubting as to which light was really the stronger."

Upon testing the candle-power of the lamps with the Trotter photometer, it was found that the gas lamps gave the following results: Cheyney Rock to Crescent, nominally 80 C.P., averaged 39·7 C.P.; Alma Street, average 29·8 C.P.; Invicta Road, average 26·2; Alma Road, average 28·3; West Street (Blue Town), average 42·7 C.P.; High Street (Blue Town) and Mile Town, from Crescent to Dockyard Gate, average 33·2 C.P.; High Street, Mile Town, from Crescent to Maple Street, average 34·6 C.P.

In one instance a double burner opposite Chapel Street, which was supposed to be of 160 C.P., gave on test 35 C.P.

In comparison with these results, the electric lamps, nominally of 50 C.P., gave the following results: Marine Parade, No. 1, 53 C.P.; No. 2, 51·5; No. 3, 50 C.P.; and No. 4, nominally 100 C.P., gave actually 110 C.P.

We have thus evidence of the great difference between the nominal and actual candle-power of the gas mantle, as compared with the metallic-filament electric lamp—apart from which, it is notorious that the former rapidly deteriorates and loses its candle-power, while the latter retains it practically for a life of 2,000 hours.

The question of candle-power is of the essence of the contracts, and although there is a guarantee of the amount of illumination in the agreements, it is practically impossible to maintain it in the case of the gas mantle, especially in the case of street lighting, owing to its rapid depreciation and frequent fracture through high winds. After the tests at Sheerness had been made, a gale of wind did a lot of damage to the gas mantles, so that the results published were the most favourable to the gas system. The local paper (*Guardian and East Kent Advertiser* of November 12th) claims credit for "waking up the gas company, who have made certain minor efforts to improve the system of street lighting at present in vogue. They have been busily putting up new mantles where before the old ragged and tattered apologies did service until their monopoly was seriously threatened."

If the managing engineers of electric supply companies, with the aid of the independent local press, followed generally the example of the Sheerness company, street lighting would soon emerge from the semi-darkness of gas, to the efficient and economical illumination provided by the modern electric lamps.

Co-operative Street Lighting.

An interesting development of street lighting by arc lamps is just being started at Bromley (Kent). Both gas and electricity supply are owned by companies, and the District Council of Bromley has a long-term contract for the lighting of the streets by gas.

The tradesmen in the High Street are naturally dissatisfied with the gas lighting, and as they cannot get any improvement through their representatives, they have simply taken the matter into their own hands, and have arranged with the electric light company for the street to be illuminated by arc lamps.

A Committee of Tradesmen has been formed, and permission to suspend the wires from rosettes on the buildings on either side has readily been given by the various property-owners, the Council giving the necessary consent.

Each tradesman pays a proportion towards the initial cost, and afterwards for the energy to run the lamps, the amount that each has to contribute being apportioned by the Committee.

It is not often that one hears of such a collective arrangement amongst tradespeople, but it is clearly a very sensible move. We commend it to other communities, where, on account of vested and other interests, the street gas lighting cannot either be improved or superseded.

Parliamentary Applications.

In the list of new Bills which have been lodged for the attention of Parliamentary Committees there is not much to excite the interest of the electrical engineer, nor are there, as there used to be, proposals which fill the manufacturer with hopes of big business if the schemes receive the required approval. Numerically the list is larger than any we have published for three or four years, but a glance will show that there are many quite unimportant applications. The mere fact that there are 80 odd notices recorded by us this year, in comparison with under 60 in 1909 and 1908, and under 70 in 1907, must not be taken as indicating a vast amount of new public electrical work in prospect; the amount of business is not in proportion to the number of schemes any more than it is in proportion to the length of imposing legal phraseology with which they are announced. A number of authorities—municipalities and companies—seek small extensions of their areas; a few provisional orders for electricity supply powers are being applied for by private parties and public authorities in respect of small areas not yet having any supply. Here and there a gas company wants powers to apply for an electric lighting order, while the transfer of the Acton electricity works *to* a company, and the Winchester works *from* a company, also form the bases of applications. Of course, there are the few usual applications by municipal supply authorities who want various minor powers incidental to the conduct of their works, which call for little comment. In the traction department, though there are one or two new tramway schemes announced, chiefly affecting Brighton and the neighbourhood, there is no feature of particular note save the large number of proposals—shall we call it an epidemic?—to run railless electric traction systems, otherwise trolley omnibuses. It will be seen that there are 14 applications of this kind, some of them emanating from corporations which already own tramway systems, but the

more important originating with private parties who wish to form new companies to operate such services in Brighton, Hove and district, in Croydon and southern district, in Macclesfield and district, in Malvern and district, in Matlock district, Oldham and Saddleworth district, and in the Western Valleys (Monmouthshire). The consideration of these proposals, it may be, will form the most interesting subject of all for the deliberations of Committees. The proceedings will be the more interesting and valuable if it is possible to produce evidence of the actual working results of the small sections which are now preparing in Yorkshire.

It will not be surprising if there is opposition of the kind, suggested in a letter in Wednesday's *Times*, where Mr. E. L. Walford says that if the powers are granted, these companies "will run their heavy cars along the roads without being at the expense of laying the tramlines or of keeping the track in repair. They will wear out the roads in about a third of the ordinary time, and pay no rates. This will throw an additional burden on the railways with which they will compete, and which are always the highest ratepayers in the district. Railway shareholders should therefore insist, through their Parliamentary representatives, on these companies being rated as railways are."

A National Engineering Exhibition.

Our contemporary, the *Engineer*, has recently been commenting upon the frequency with which private organisers have of late been running engineering trades exhibitions, and pointing out that such exhibitions run by private individuals, however worthy, cannot be expected to produce satisfactory results from the national point of view, nor are they calculated to enhance the reputation of British engineering. The electrical engineering trade has in a large degree overcome the difficulty and removed any reproach, by running its exhibitions under the auspices of fairly representative associations, though even under these conditions it has to be admitted that past experience has shown that large and important firms withhold their co-operation. The *Engineer's* criticisms are preparatory to what presumably we are to regard as a preliminary announcement of a great national engineering exhibition which shall impress the entire world. The idea possesses a good deal of fascination, and will, we do not doubt, receive the approval of many leading authorities in engineering circles. If we consider the greatness of British engineering, the enormous proportion of our national industries that are founded upon or linked to it, the leading part that it is destined ever to play in the development of the world and its resources in countries as yet hardly touched by the hand of civilization, the proposal in its first stage must impress us. Our contemporary has not written its editorial on the subject merely because it had so much space to fill. It remarks that the motor-car firms have their associations, the gas engine builders are organised, the machine-tool makers have formed an association for the protection of their interests, and it adds that perhaps some day, not far distant, we shall find one or two such societies uniting to form an exhibition for their mutual benefit. The writer does not mention that the electrical trade has already done this sort of thing on several occasions, and has its plans all cut and dried for another great effort at Olympia next year. The large idea that our contemporary has in mind could hardly be carried into effect, if adopted, in time to clash with that event, but the *Engineer* has made inquiries in many directions, as the result of which it finds that there exists a decided sympathy with the proposal. It is thought that the time, coupled with the commencement of a new reign, is appropriate for the promotion of a national—or international—exhibition which shall be the medium for demonstrating to the world, and especially to our Colonies, that Britain is not—as is so frequently asserted—behind her engineering competitors on the Continent and in America, but is, as ever, a force to be reckoned with in engineering affairs. "To be a success such an exhibition, whether it be national or international, must be entirely independent of the showman, and must be organised by and for the engineering industry alone, and, above all, must be free from side shows and gew-gaws. Embracing as it should the cream of the products of our mechanical, electrical, textile, and other branches of engineering, such an exhibition would, we feel convinced, not only be the means of attracting trade from all parts of the world, but would also do more to re-establish the prestige of this country in engineering than all the small one-man shows we have recently seen put together."

The formation of a consultative council of the presidents of the leading engineering societies to test the feeling of the trade generally upon the matter, and to decide upon the scope of such an exhibition, is suggested as a first step. Other steps, such as ensuring the co-operation of the several trade organisations concerned, would apparently follow.

Seasonable Benevolence.

The deluge of Christmas appeals is beginning. Among all the very worthy causes, we need still to remember that Charity *begins* at Home; and, as an object especially deserving of the support of the generously inclined among electrical men, Mr. Walter Davenport, the secretary, asks us to remind our readers of the existence and claims of the Electrical Trades Benevolent Institution. We have so often urged the trade to support this fund, that a mere reminder should be sufficient to draw a number of subscriptions and donations just now.

The Gas-Pump Generator.

The happening of the unexpected is once more exemplified in the remarkable possibilities of the Humphrey gas pump. When this was introduced a year or so ago, its relation to electrical work appeared to us to be so remote that we felt hardly justified in publishing particulars of it for electrical readers, though as an example of engineering genius it was one of the most striking inventions of the present century. Remarkable progress has since been made, however, and numerous applications have been found for the invention—not only for pumping on high and low lifts, with or without suction, but also for compressing air and propelling ships, and not least, perhaps, in importance, for generating electrical energy through the medium of hydraulic turbines. It is true that not all these developments have as yet been fully realised, but their practicability is clearly shown in the paper read by the inventor before the Manchester Association of Engineers, which we abstract briefly elsewhere in this issue. The importance of the idea in connection with the generation of electricity lies in the very high thermal efficiency attainable—over 40 per cent. from gas to water—while blast-furnace or producer gas can readily be employed. The cost of such an installation, consisting of pump, pressure regulator or elevated tank (of small capacity), and hydraulic turbo-generator, would compare favourably with that of any gas-engine plant, and in view of the high efficiency of modern hydraulic turbines, the over-all efficiency would be upwards of 30 per cent. Now, Mr. Ferranti in his Presidential address only stipulated for 25 per cent. as a minimum. There appears to be no reason why the Humphrey pump should not be constructed in very large sizes—one of 1,000 H.P. is already being built—while high-pressure turbines and electrical generators have reached an extremely high degree of perfection. It will be seen, therefore, that Mr. Ferranti's requirements are already in a fair way of accomplishment so far as the generating plant is concerned.

Probably the gas producer would be the least satisfactory portion of such an installation, in the light of present knowledge; but we have no doubt that rapid progress will be made in this connection when the need arises.

The Humphrey system of generating electricity, in fact, deserves serious consideration; it may, and not improbably will, become a factor of the first importance in connection with the future development of electricity supply.

THREE-PHASE ARCS WITH FOUR CARBONS.

By L. CROUCH.

The problem of obtaining a steady and efficient light from a three-phase arc lamp is neither a simple nor a recent one. Thus, early in 1904, Mercanton * published details of tests conducted with a three-phase arc in which three carbons were placed at the apices of an equilateral triangle and connected one to each phase of a three-phase supply; the luminous efficiency of such a lamp was found to be considerably higher than that of a single-phase arc, and by using one of the three types of regulator (according to the light required) invented by Bentivoglio and Siciliani (Milan) † fairly satisfactory results were obtained in practice, though the whiteness and steadiness of the light left much to be desired.

Yet earlier, a lamp with three vertical carbons and operating without a regulator had been patented in 1901 by the Società Generale Italiana Edison di Elettricità (Milan) ‡ and two other lamps by R. Flemming (Swampscott, Mass.). § One of the latter lamps had an arrangement of carbons similar to that employed by Mercanton, while in the other six vertical carbons were used, three connected to the three-phases of supply, and three connected to the neutral point of the three-phase star (usually the neutral of the three-phase transformer employed).

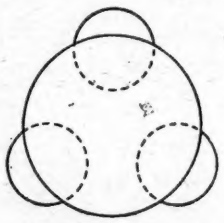


Fig. 1.

In spite of a low specific consumption, these lamps never came into general use, for two reasons:—(1) They constituted a too powerful source for most requirements; (2) It was found that the three arcs did not always light in unfailing sequence, so that the net light was frequently more

Fig. 2.

Fig. 3.

vacillating than that of a single-phase arc of the same frequency (while, of course, the main object of using the three-phase arrangement is to equalise the light obtained from an A.C. arc).

Quite recently ¶ Righi (Bologna) has obtained good results by the use of four carbons with the added advantages (so it is claimed) of simple regulating mechanism and equally effective operation in all sizes of lamp. A differential single-phase lamp may be converted to three-phase operation by replacing the lower carbon by a group of three carbons arranged symmetrically round the central axis at the apices of an equilateral triangle (of side 12-15 mm., the lower carbons being about 8 mm., and the upper carbon 20 mm. in diameter, see fig. 1). The carbons are adjusted so that the upper rod touches the three lower carbons simultaneously (the use of a good quality carbon should obviate any operative difficulties due to unequal burning of the lower electrodes). The fourth carbon is insulated, and hence, as might be anticipated, its consumption is surprisingly low.

The three arcs which form between the three lower carbons (connected one to each phase), and the fourth close the three-phase star circuits; the light from the six craters is mainly downwards, reflectors are unnecessary, and the constancy of illumination is quite comparable to that effected by a D.C. arc. The thick wire regulating coil is connected in series with one phase, the pressure coil being shunted across two phases, or across one phase and the fourth carbon, according to the voltage employed. The construction of a suitable motor regulator (rotating differential field) presents no special difficulties.

Although accurate quantitative measurements as to the efficiency, &c., of the four-carbon lamp under its best operating conditions are not yet available, several interesting phenomena have been observed, and may be briefly referred to. A simple hand-regulating gear was employed in the following instances.

Suppose the arc be struck between the three lower carbons, the fourth being so far away as not to influence the result; a reddish somewhat unsteady light results, the arc having the general appearance shown in fig. 2: the light is thrown almost wholly upwards. Suppose then that the fourth carbon be gradually lowered: even when it comes quite near the lower three carbons, the characteristics of the arc between the latter are hardly affected *until* craters are also formed on the fourth carbon. When the latter event occurs there are six craters instead of three, and to this fact are attributable the improved light distribution (see fig. 3), the whiter nature and higher intensity of the light, and its greater steadiness, as well as *the lower power consumption*, as indicated by the wattmeter in circuit.

Mercanton three-phase arcs have proved stable on circuits of 17 cycles per sec. or even lower frequencies, probably owing to the close proximity of the three craters preventing the sufficiently rapid dissipation of heat to allow of extinction between the current pulses. The fourth carbon as employed by Righi should yet further prevent heat dissipation, and while improving the efficiency of the lamp as above, should permit of its satisfactory use on traction circuits of 15 cycles per sec. Hitherto only incandescent three-phase lamps have been available for such service.

Under certain conditions Righi has observed the formation of luminous excrescences in place of craters on the fourth carbon; these tubercles naturally point towards the respective lower carbons, and their formation is probably of considerable importance to the running and efficiency of the lamp. Researches still proceeding will throw light on this and other points of uncertainty in connection with what appears to be a most promising advance in three-phase illumination.

* *La Lumière Electrique*, January 30th, 1904.
† *Elettricista*, November 15th, 1904, and January 1st, 1908.
‡ *L'Electricien*, March 28th, 1903.
§ *L'Electricien*, October 10th, 1903.
¶ *La Lumière Electrique*, April 9th, 1910.

Exhibition Awards.—The Synchronome Co. inform us that, in addition to gaining the Diploma of Honour at Brussels, their system of electric clocks was used extensively in the Centenary Exhibition at Buenos Ayres, and was awarded a Gold Medal.

Manufacturing in Sweden.—The Allmänna Svenska Elektriska Aktiebolaget, of Stockholm and Vesteras, announces that the company's past year may be regarded as a record period in the construction of generators, motors and transformers. During the year the company has had to carry out the large contracts for the power station near Trollhattan (which has been completed for 80,000 H.P.) and at Rjukansfos, and it is at present occupied to the full amount of its capacity. The town of Helsingfors has recently ordered 20 tramcars, with complete equipment, and the orders already in hand will afford sufficient work during the winter months.

A NEW FIRE-ALARM SYSTEM.

We have recently had an opportunity afforded to us for the inspection of a very novel system, installed in a West-end cloth warehouse, for giving warning to those concerned in the event of an outbreak of fire on the premises.

The system, known as the Reichel Automatic Fire-Alarm System, was invented by Mr. L. T. Reichel, some time chief electrician to the New Zealand Government Public Works

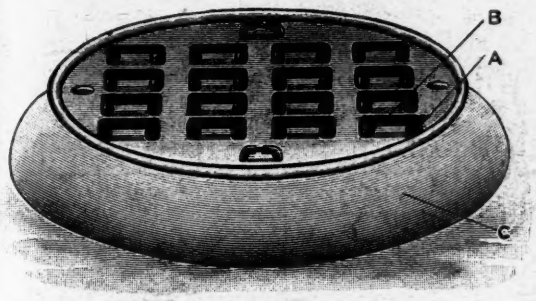


Fig. 1.

Department, who, we understand, resigned his Colonial appointment in order to develop his system abroad and at home.

One of the novelties in the system lies in the fact that it is entirely unaffected by dust and vibration, for there are no line contacts involved, neither are there any batteries having what may be termed primary functions in the system. Upon the care spent upon the maintenance of batteries entirely depends the success of many fire-alarm schemes—a detail involving a personal element often found wanting when an emergency does arise.

The Reichel system depends upon the use of thermopiles made up of couples of bismuth and an antimony alloy. Such couples—any number of which may be chosen according to the degree of sensitivity required—are mounted in a porcelain block C in such a way that one series of junctions A B only is exposed to the air (fig. 1). The blocks, with their couples protected from accidental mechanical injury by a suitable grid, are mounted on the ceilings of the apartments which it is desired to protect. We understand that this thermostat may be made of such design as to harmonise readily with any decorative scheme. A detector of this type possesses a useful feature in that a room may be gradually heated to any degree of temperature that comfort or utility demands without affecting the alarm device, due to the fact that the length

Fig. 2

of each couple is so short that the temperature lag of the unexposed junction follows closely behind the exposed junction, so that, at an ordinary rate of temperature increase, little or no thermo-E.M.F. is generated; whereas, if a sudden rise of temperature occurs in a room where the pile is installed, such as would arise from even a small conflagration, a thermo-E.M.F. will instantly be generated sufficient to operate the alarm. This feature might have somewhat of the nature of a drawback where it is desired to protect apartments from the effects of a smouldering fire, but this difficulty is surmounted in the Reichel system by an auxiliary device which causes the warning to be given should the temperature at any time reach a predetermined figure.

Groups of from one to ten such thermopiles are connected by insulated wires in one series circuit, and each of the circuits is connected to an indicator mounted in a suitable case with others for different circuits (fig. 2).

The indicator, fig. 3, consists of a sensitive moving-coil relay whose tongue carries a light iron disk I upon which the platinum contact point is mounted. In juxtaposition thereto is an adjustable iron screw A S which carries the fixed contact, and which is magnetised. These contacts form part of a local circuit, including a suitable battery and such warning bells B as are necessary. A deflection of the coil from its normal position moves the iron disk into the range of magnetic pull of the screw, when the former is pulled over and the contacts held firmly together until the coil is restored by hand. The adjustable screw forms a ready means of fine adjustment of the range of operation of the warning, already approximately determined by the selection of the number of couples in the detectors T. The moving coil also carries an arm to which is attached a disk D, which, according to its position, displays the words "safe" or "fire" through a window in the indicator case.

The indicators, &c., are mounted upon a central board, from which the various thermostat and warning bell circuits radiate in the usual way, and the board is fitted with various

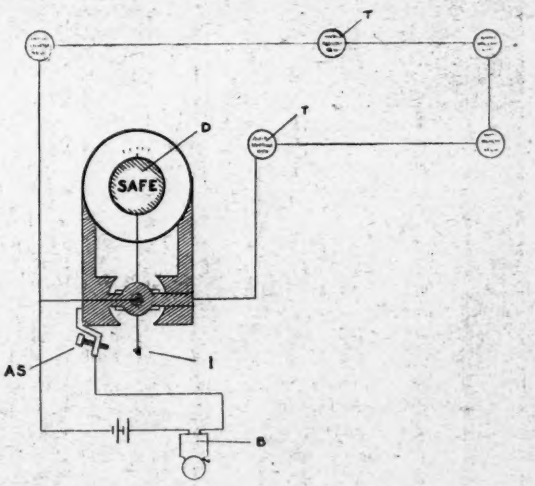


Fig. 3.

control switches, means for testing the condition of the local battery, and an ingenious method for testing the continuity of the alarm circuits by the insertion of a test detector, which, when breathed upon, causes the appropriate indicator to deflect should its circuit be continuous.

The efficacy of the system was demonstrated by the fact that, in a room whose temperature may vary as widely as from 150° F. in the day-time to somewhere about 40° F. at night without causing false alarms of fire, it was sufficient merely to place one's hand upon one of the thermostats for a very brief period for the alarm to be set going.

The foregoing is a brief outline of a system which should be welcomed by the British fire and salvage companies and the insurance companies, a system, too, which, whilst new to this country, is not an untried one, for it is understood that it has already been in operation in New Zealand for some time.

Ship-Lighting Lamps. — Messrs. Siemens Bros. Dynamo Works, Ltd., of Tyssen Street, N.E., have obtained a very large contract for their tantalum lamps for ship lighting from one of the largest shipbuilders in the United Kingdom. The order is said to be the largest placed for metal-filament lamps for such a purpose.

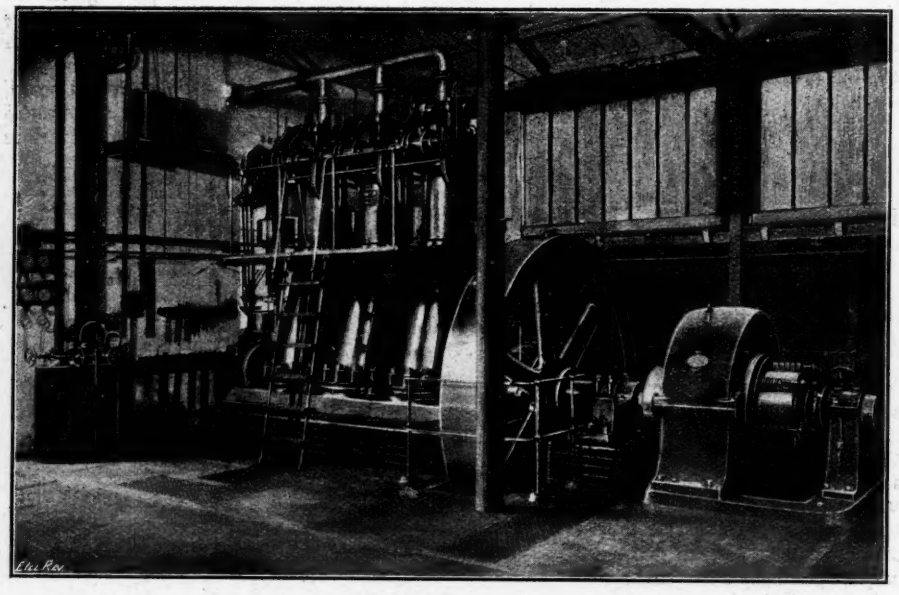
D

NEW DIESEL PLANT AT FELIXSTOWE.

On Saturday last, through the courtesy of the directors of the Diesel Engine Co. and the Suffolk Electricity Supply Co., we were present at the official inauguration of a new 235-H.P. Diesel engine plant at the Felixstowe works of the latter company.

After a brief inspection at the works, where the chairman of the District Council started up the new plant, those present, including the members of the local Council and representatives of the Supply Co., adjourned to Felixstowe's most recent hotel—The Cliff—where the occasion was fittingly celebrated by an excellent dinner, with Mr. W. T. Batho, of the Diesel Co., and Mr. P. C. Peddar, of the Electricity Co., as joint chairmen.

An evening brimful of speech-making, music, &c., followed—in fact, the Election results had been discussed, and the streets were in total darkness, thanks to the unequal fight between wind and gas mantle, ere the guests separated. Curiously enough, the meeting was one where the rival illuminant was well represented, the vice-chairman of the local gas company, in his capacity of chairman of the U.D.C., having previously officiated at the starting-up of the new plant at the electricity works.



New Diesel Engine Plant at the Felixstowe Electricity Works.

The situation at Felixstowe is peculiar, inasmuch as the Council recently purchased the Felixstowe and Walton business of the Suffolk Electricity Supply Co., but entered into an arrangement with the latter to carry on the undertaking for a term of years.

The gas company is well represented on the Council, and it is to be feared that the conflict of private and public interests, which unavoidably takes place, considerably retards the progress of electric lighting in the district, and incidentally depreciates the value of the property which the ratepayers are financing, and will ultimately acquire.

The Felixstowe undertaking is a comparatively small one, and it suffers, in common with other seaside concerns, from a short season load in July and August, giving practically twice the demand usually experienced in the winter months.

Up to the present the Supply Company, of which Mr. Napier Prentice is the manager and secretary, has operated a suction gas plant, consisting of a 100-KW. four-cylinder Fielding-Mather set, a 65-KW. horizontal Stockport-Peebles set and two smaller horizontal 20-KW. sets, with the necessary producers, scrubbers, &c.

Provision is made for running the plant on town gas when required, and as normally the light load periods are supplied by a 130-cell D.P. battery, working in conjunction with a Lancashire reversible booster, installed at the generating station, Mr. Prentice has been able to obtain comparatively economical generating costs with the original plant, in which the fuel consumption was some $2\frac{1}{2}$ to $2\frac{3}{4}$ lb. per unit.

Our readers will probably be aware that the question of extensions was recently thrashed out in considerable detail, the Council's consulting engineer, Mr. R. P. Wilson, recommending an extension of the existing plant by means of a Diesel engine and generator in preference to an alternative scheme which involved the erection of steam plant on a site some distance from the town, where facilities for condensing, &c., could be obtained.

The new plant which has now been brought into use, consists of a three-cylinder 235-H.P. Diesel engine (supplied by the Diesel Engine Co.) coupled to a six-pole 150-KW. 220-volt G.E.C. generator, running at 195 R.P.M. The engine is of the latest type, fitted with an improved oil pulveriser, and guaranteed to run smokelessly at from one-fifth load to 15 per cent. overload. Ring lubrication is provided on the main bearings, and small oil pumps are fitted for lubricating each gudgeon pin and piston. The engine works on the well-known four-stroke cycle, and starts up on compressed air, which is admitted to the first cylinder through an extra or fourth valve fitted on the cylinder cover—each cover being provided with an exhaust and air inlet valve of the mushroom type and a needle valve for fuel injection.

A Reavell three-stage air compressor direct coupled to the crankshaft supplies the air for starting-up and subsequently for injecting the fuel when running, the pressure ranging from 400 lb. to 900 lb. per sq. in. according to conditions.

The compressed air is fed to three receivers, two of which are reserve starting bottles, either one being sufficient to start the engine 10 times, while the third is the injection receiver normally in use, the air from which is used to force a spray of oil into the highly compressed and heated charge of air contained in the cylinder at the commencement of its third or working stroke, during which combustion takes place.

As is well known, the Diesel engine is not of the explosion type, and the cylinder pressure does not rise above that due to compression; consequently, the engine runs quietly and without shock. Moreover, the ingenious system of governing the oil admission to every working stroke ensures a very even turning moment.

The standard governor arrangement is fitted, in which the governor works a small oil pump and more or less opens the pump suction valve during the delivery stroke, so as to vary the amount of oil delivered. The oil at Felixstowe costs at present 50s. per ton, and the Diesel Co. guaranteed a consumption of ·702, ·768 and 1·029 lb. of oil fuel per unit at full load, two-thirds load and one-third load respectively, while the actual results have been ·68, ·671 and ·828 lb. of fuel per unit for the loads mentioned. Thus the company came well within their guarantees, as was also the case with the cooling water, for which 2·85 gallons per B.H.P.-hour are required, as against a guarantee of 4 gallons. The cooling water is supplied from a 5,000-gallon roof tank, with a Klein cooling tower standing over it, and a motor-driven centrifugal pump in the engine room returns the water from the cylinder jackets to the top of the tower. A thermometer and cock are fitted in each jacket discharge pipe, in order to regulate the discharge temperature to about 120° F. The cooling water installation is sufficiently large to provide for treble its present

duty. The Diesel engine is particularly suitable under conditions such as obtain at Felixstowe, and its remarkably uniform fuel cost—under 0·2d. per unit—over a wide range of load, and total absence of stand-by charges, are expected materially to improve the generating conditions there.

The local electricity supply is on the two-wire system, at 200 volts pressure, and practically all by means of bare overhead wires; the distributors run along the *back* of the houses, and are attached thereto by insulators clamped on to chimneys, with services teed off as required—an arrangement which served the Electricity Co. well and practically eliminated wires over streets, but which will, in future extensions, be replaced by street poles at the discretion of the Council. The company supplies 40 Johnson & Phillips enclosed arcs, along the sea front, and a dozen or so tungsten street lamps, and if price had not been quite a secondary consideration to the Felixstowe Council, the company would, ere this, have captured the whole of the street lighting, the ratepayers benefiting to the extent of 5s. to 6s. for each post converted, on the prices quoted, not to mention the additional advantage of reliable illumination on a windy night.

The company is energetically pushing the sale of energy for heating purposes, and has introduced the Norwich system of charging with that end in view, and an excellent, though fruitless, suggestion, due to Mr. Napier Prentice, was the supply of a kettle and one lamp to each of the numerous beach tents, at an inclusive charge of 10s. per season.

However, it is to be hoped that under the more intimate conditions which now exist, the Council will see its way to assist the company in developing the undertaking for the good of both.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

Commercial Training of the Engineer.

In his inaugural address at Birmingham, before the Institution of Electrical Engineers, Mr. M. S. Railing said: "The young electrical engineer abroad is encouraged to study in addition to his own science, the technology of allied trades, and to train himself as well in languages, in commercial law, in natural economy, and in commercial routine generally. I plead that such an excellent course may some day be adopted in this country as well. I further plead that the commercial side of engineering should be considered in our present system of apprenticeship."

For many years I have been much interested in the question of giving young engineers some commercial training; in fact, I first recognised the importance of it a dozen years ago, when I had some of the pupils at a well-known electrical manufactory through the estimating department of which I then had charge.

Most of them were like fish out of water when they first came to me, and some never did any good, for although technically sound, they had not the methodical office habits and natural grasp of financial detail to make their stay in the estimating department profitable.

Other men dropped naturally into the work and learnt to draft specifications, dictate business letters, or make up detailed estimates of such straightforward matters as dynamos, lighting plants, &c. Some of them are successful sales engineers to-day, or in charge of estimating departments of various firms.

Now, clearly, it is not possible or advisable for firms to allow a number of young men to pass through the commercial departments. For one thing, there is usually not office room, and for another it is not wise for a firm's cost sheets, and other financial data to become widely known.

Therefore, if young engineers are to be able to obtain some idea of commercial methods, the details of estimating, &c., these matters will have to be systematically taught.

Four years ago a course on Quantities and Estimates for Mechanical Engineers was started at the Northampton Institute, Clerkenwell, and Dr. Mullineux Walmsley and Mr. Larard have since been successful in persuading the City and Guilds to establish an examination in the subject.

On my return from Australia about two years ago, Dr. Walmsley asked me to draw up the syllabus for a course on Quantities and Estimates for Electrical Engineers; this is the second session I have been lecturing on that subject, and I think it may be said to be successful from the fact that the class is about 25 strong, and is entirely composed of young men who have recently started in business.

The syllabus is too lengthy to be reproduced here, but the heads are:—Private and public lighting, estimating office work, works costs, electric power in factories, tramway equipment, power transmission, town supply, &c.

My methods are somewhat unconventional. For example, I make a practice of distributing to the students catalogues and price lists which the various manufacturers and contractors are good enough to send. I spend some time each lecture in commenting on any data in these catalogues, and encourage the students to annotate the copies, as a marked catalogue is much more valuable than an unmarked one.

Occasionally we make excursions outside. For example, to the Business Exhibition at the Olympia, when several firms gave special demonstrations of their apparatus and methods. One evening a representative of Standardised Engineering Publications came to the Institute and demonstrated the method of filing catalogues and lists; whilst another evening we went to the offices of Systems, Ltd., when the manager, Mr. Harrison, gave a most interesting talk on card index systems and how to apply them to engineering work.

Last week the students were shown how to use the Patent Office Library in Chancery Lane, so as to enable them to make a quick search for a patent specification or for articles bearing upon any particular subject they wish to read up.

Many useful matters which young engineers have to pick up at the present time in a haphazard way can be usefully taught, and certainly amongst them are such subjects as quantities and estimates, commercial and patent law, and the principles underlying business routine. Young engineers need to know something of these matters, if for no other reason than to save themselves from being improperly exploited by the company promoter type of individual.

E. Kilburn Scott.

Bromley, Kent, *November 29th*, 1910.

Static Transformer Switching.

Among many station engineers there appears a difference of opinion as to the correct method of switching large "static" transformers in parallel.

According to theory, we are told to close in the low-tension side first, so that the core may be magnetised from the secondary rather than from the high-tension side, but in practice the writer has seen instances where, by adopting this method, it has been found that such a rush of current takes place as to trip out the secondary switches. On the other hand, a rush of current often takes place when the primary side is closed first, but not to such a great extent as in the former instance, and not to such an extent as to trip the switches.

Having heard arguments in favour of each method, the writer would be glad to know the method that is found in general practice to be the most satisfactory, and the theoretical explanation recommending such method.

Station Engineer.

Clydebank, *November 30th*, 1910.

The Supply of Lamps by Electricity Works.

I was very interested in the article by "Metal" in your current issue.

Whilst thanking him for the information given in the shape of facts appertaining to his own station, I beg to differ from some of his opinions, and also to enter an emphatic protest against the free supply of lamps by electricity works.

The very first portion of his article is open to discussion, inasmuch as he infers that the duty of a station is to sell

light, not *current*. If all stations were worked and run on this basis to-day, I am afraid the balance-sheet of many concerns would be sorry reading for the engineers and managers.

Does "Metal" wish one to understand that 20,000 25-c.p. metal lamps connected to his mains are of more value to him, at the end of the year, than 20,000 16-c.p. carbon lamps, as he would be selling more *light* in the one case than in the other, and is he anxious to cultivate house lighting customers who burn a couple of metal-filament lamps for a few hours each day out of a total of 12 or 14 lamps of various kinds installed in preference to power consumers who would be using current on a much larger scale for eight or nine hours per day, and is he deliberately showing the cold shoulder to possible heating and cooking consumers?

Personally, I cannot at the moment understand why there should be, or are, so many disconnections as "Metal" speaks about, as metal lamps have now been on the market for so long, and advertised so much, that it appears almost incredible that disconnections should occur through heavy lighting bills before metal lamps have been tried, and it is doubtful about the bills being heavy when they have been tried.

If a man has a bad light it is almost safe to say, to-day, it is his own fault, and very often it is because he adopts a penny-wise and pound-foolish policy by buying a shilling carbon lamp instead of a metal lamp at four shillings.

"Metal" treads on dangerous ground when he says "the station *must* supply lamps to consumers if the best is to be got out of the electricity supply." This statement is very definite, but I have no hesitation in denying the truth of it. I very strongly object to the statement and to free lamp supply by central stations.

An ordinary everyday business man reading a statement such as "Metal" makes would wonder what class of men were engaged in the electrical trade and industry generally outside the supply stations. Apparently, contractors are not capable of advising a customer what sort of lamps are going to suit his purpose best. I beg respectfully to inform "Metal" that the contractors, as a body, are quite capable of doing the necessary thinking for their clients without his intervention, and the *best* can be obtained without a free lamp supply.

I think it is time that the free supply of lamps by all stations where such schemes are at work was done away with, and in its place a 5 per cent. cash discount given when the accounts were paid; this would be preferred by large numbers of consumers to-day. The whole thing is unfair in more ways than one.

Speaking generally, lamp renewals are the only source of revenue a contractor has to look to after putting in an installation, from that particular installation. Let the supply authority sell its current to the consumer after the contractor has spent, very often, considerable time and money in obtaining that consumer, and leave an opening for the contractor to do a little business in the future with the consumers.

When a contractor gets a new consumer on the mains, the supply authority are selling him juice daily, whereas the contractor, under the shadow of a free lamp supply, cannot get a look-in. Is it fair? No.

Again, looking at the scheme referred to by "Metal," probably his own, he says the prices for lamps are kept at the lowest possible rates, this, I presume, to keep out the contractor, as he further says, "it is better to lose on the lamps than reduce the charges for current," in other words, it is better, from "Metal's" point of view, to give the customer something to persuade him to have the station's free lamps, and keep paying the price he is doing for current, rather than the consumer should pay the proper price to a contractor for his lamps and have his current at a lower figure. I should like to ask "Metal" if his is a municipal undertaking, and what he thinks the ratepayers would say and do if they knew how one, I presume, of their servants deemed it advisable to put a penny in one of their pockets, under the pretence of giving them something, whilst he thought it quite right to take sixpence out of the other pocket by keeping up the price for current. And what about the contractors in his own town and district who are adding grist to his mill daily? What encouragement!

I am inclined to think that, if "Metal" came out into the open, he would have a pretty warm time at the hands of those whom his policy more closely affects.

He not only believes in supplying lamps free, but also in carrying out all kinds of repairs, just as an act of kindness, and supplying free brains for customers to think for them—in fact, anything to blind them so long as his price for current is not questioned.

No, "Metal," the free supply of lamps is not the fit and proper thing for a station to undertake, as it is unfair to the consumer, the ratepayer generally, and the contractor particularly.

Give the consumer an extra 5 per cent. discount or reduce your price for current and leave him a free hand to get his lamps from where he wishes or otherwise would do.

I have had numbers of cases where consumers have never had a "free lamp," through various causes, in other cases they have obtained lamps they have not been able to use, and sometimes I have found them stored, new, in hundreds. The plea used to be that the free lamp supply was instituted and carried on to ensure consumers having a change of lamps occasionally, in the days of the carbon lamps, as otherwise the lamps would have been kept in use when they had passed their economical stage.

To-day, all that is past, and there is no doubt that the free lamp supply schemes are out of place, as they take away business which ought to be in the hands of the contractor who is also a ratepayer, and rob him of legitimate business which ought to be in his hands, and his alone.

Harry Moss.

Bradford, *December 5th*, 1910.

Municipal Wiring.

When I read Mr. Bowden's letter on this subject, I was seriously tempted to laugh. First of all, he says that I do not write from a wireman's point of view. Possibly he takes me for a member of the Electrical Contractors' Association. He then says, I have made a false statement *re* list of questions sent out by this Association, and in the very next sentence admits the truth of it.

May I ask who is the judge of the man's drunkenness, and of his incapacity, and whether the man himself has a chance of seeing what is put upon his sheet? I claim that it is possible for a life-long abstainer to have a charge of drunkenness, or any other charge for that matter, made against him, and the man not to know it, and Mr. Bowden bears me out.

If the Editor will publish the list of questions, I will send the sheet, or, better still, let Mr. Tate forward the list to the Editor for publication, and let your readers judge whether my statements are without foundation. Surely, if everything is fair and above board no member of the Association can have any objection to this. My other charges against the majority of the members of the E.C.A. no-one, with truth, can deny. From Mr. Bowden's letter, I gather that premises that are wired by municipalities are done by the "crême" of our trade, and the contractors' work by the rest, with the additional risk to life and property, through fire, &c., thrown in. Even I do not go as far as that. I may say that neither now nor at any time have I worked for a municipality, and at present I am working for a contractor. I should be very pleased, indeed, to meet Mr. Bowden or any members of the Contractors' Association on any evening, at any place, to discuss this matter. Any humble effort of mine that would lead to better and fairer conditions between wiremen and contractors I should be most happy to make, and I am sure the advantages would be patent to all.

W. J. Webb.

London, S.W., *December 3rd*, 1910.

Lantern Slides.—The Electrical Co., Ltd., of 122-124, Charing Cross Road, London, W.C., ask us to announce that they have a large number of lantern slides illustrating the advantages of the use of electrical drive and electric heating, as well as a considerable number of photographs of various types of machines, apparatus and arc lamps which they will be pleased to loan to Corporation engineers or electrical contractors for use. In all there are some 300 or 400.

LEGAL.

Griffiths and Another *v.* Benn.

(*Concluded from page* 901.)

On re-entering the witness box on Tuesday, November 29th, Mr. Fell stated that he wished to correct what he had said on the previous day. He found that the resistance at Burdett Road was laid by the G.B. Co. Referring to the alleged quarrel between himself and Mr. Bedell, Mr. Fell said that he remarked that he wanted a little less theory and more practical result. The G.B. Co. were told that if the L.C.C. were satisfied with the car equipment, they could go ahead with the whole 48 equipments. The L.C.C. had made some magnets, but that did not affect the company at all. They were regarded as a make-shift job and the L.C.C. only asked the company to help to get the system going. Witness contended that the magnets operated the studs successfully.

The Judge: They did not. It was unsuccessful in July.

Witness: That had absolutely nothing to do with the magnets.

Mr. Greer: That is your opinion. I suggest your magnets would not operate the studs properly?—I don't agree.

The magnet would not operate at high speeds?—I am not aware that that is so.

Witness said it was pointed out to Mr. Mordey that with the original G.B. equipment they could not run more than 14 miles an hour without sparking. The safety breakers were supplied by the L.C.C., but some bobbins which were made were copied from the plaintiffs' bobbins.

Re-examined by Mr. McCardie, Witness said that he objected to the alterations of the cars, as all the parts were designed to be interchangeable.

A lively discussion occurred between the counsel and the Judge as to whether the question of the motive for the salting of the roads should be gone into. The Judge said he would not hold an inquiry as to whether the County Council had a right to salt a road. After the Judge had said he would take no note of the matter, Witness, in answer to questions, stated that where there were conduit lines the L.C.C. asked that the putting down of salt should be prevented as far as possible. Horse trams were being run over the Mile End route, and the salt was only placed where the horses ran.

Mr. Maurice Fitzmaurice, chief engineer of the London County Council, said there was no ground for saying that by his personal hostility he prevented Mr. Griffiths from getting the work of laying the Mile End track. The work of putting in the overhead system on a portion of the Mile End route had been given to Messrs. Dick, Kerr & Co., and he desired to avoid having two contractors on the job. He suggested the change in the access boxes, because the originals were not sufficiently strong for the Whitechapel traffic. As he had recommended the system to the Council, he wished to see it succeed. Although the G.B. Co. reduced their royalty he still believed they would give the Council advice without extra payment.

The Judge: Had it not occurred to you that Griffiths had better do the track work?—No, it did not.

The Judge: It would occur to me.

Mr. Eames (for plaintiffs): Could you have got rid of Messrs. Dick, Kerr & Co. by cancelling their contract?—Yes.

The Judge: Why did you not do that? It would have been the straight thing. Messrs. Dick, Kerr went one way, and Mr. Bedell another.—Witness said he was frequently down in the Mile End Road, and had no complaint to make. The access boxes had absolutely nothing to do with the rejection of the G.B. system.

Regarding the alleged failure of the G.B. Co. to supply certain drawings, Witness said he would suggest that on the grounds of common decency, an inventor whose system was being installed, would have supplied drawings. Continuing, witness said that the whole question about access boxes and sumps, had absolutely nothing to do with whether the G.B. system was good or bad, and the whole thing was an absolute waste of time.

Mr. Eames: And whether explosions took place or not?—You may have occasional explosions in the beginning of running with any system. I am waiting to get to some of the important things. Witness added that if it had not been for the live studs the running would not have been stopped.

Mr. Eames: We say Mr. Mordey got over that difficulty?—I do not accept that. I think all I said to the Council was that Mr. Mordey's report was not conclusive. I would say so now. Mr. Mordey did not get rid of any live studs.

Re-examined by Sir Edward Clarke, Witness stated that, at the time the Mile End Road experiment was being carried on, the Council had only power to lay 24 additional miles of tramway. They had got power to lay many more miles since, but he could not, of course, say how far the G.B. system would have been extended had it been successful.

Mr. John Bowden, who was rolling stock superintendent of the L.C.C., stated that he did not, as had been stated, recommend the insertion of a piece of gun-metal in one of the magnet poles.

Mr. Way, who made the amended design for the access box covers, said he did not force any alterations upon Mr. Bedell. He understood Mr. Bedell agreed to them.

The resident engineer for the Mile End track and the clerk of works, as well as the last two witnesses, stated emphatically that they did all in their power to assist the G.B. Co. to make the system a success. The man who took out the salt cart which did the salting, of which complaint was made, stated that he acted under the instructions of the foreman, and salted all the track on which the horse trams ran.

The Jury expressed a wish to hear what the foreman had to say, but he was not in Court.

In his address to the Jury, which occupied an hour on Tuesday and nearly all the forenoon of Wednesday, Sir Edward Clarke maintained that all Sir John Benn's speeches and remarks related wholly to the G.B. system as laid down in the Mile End Road. Sir John Benn had never said a word about Lincoln, and he asked the jury to believe him when he said he had not got it in his mind at all when he wrote and spoke on the subject of the stud tramway.

For the plaintiffs, Mr. Greer urged that Sir John Benn, under the smart of his mind caused through his defeat by the Moderates in the L.C.C., made an attack upon his opponents, in the course of which he made allegations not against the G.B. system as installed in the Mile End Road, but against the system as a system, saying it was a mischievous and impossible system; a system which imperilled the lives of those in the East End of London, and deserved the condemnation of all competent experts. No one, said Mr. Greer, could imagine anything more likely to injure the reputation of Mr. Griffiths and Mr. Bedell. Counsel added that he had no charge against the L.C.C. officials, but once having reported against the system they made up their minds, and were thereby unable to attach proper importance to the results of Mr. Mordey's experiments.

The judge's summing up was comparatively short. He asked the jury to decide whether the words complained of applied to the Mile End Road system or to the system of G.B. traction generally. If it referred to the system laid down in the Mile End Road, it was not denied that it was a failure, although it was stated that it was not a failure of itself but owing to the manner of its installation. Regarding the speeches in the London County Council, privilege would hold there unless the jury were convinced that there was a governing motive in Sir John Benn's mind if he wished to get votes and did not care what he was saying so long as he could get an advantage over the other side. With the resolution of the Council to abandon the system, its prospects went in London, and that did not lie on Sir John Benn's shoulders. His Lordship then formulated a number of questions for the jury.

After a short deliberation, the jury said they did not see their way to get finished with the matter that night, and at the suggestion of the Judge and with the consent of both sides, the jury were allowed to go home overnight.

On Thursday morning, after about two hours' deliberation, the jury returned the answers to the questions as follows:—

Were the words defamatory?—Yes.

Did they refer to the plaintiffs?—Yes.

Were they expressions of opinion or statements of fact?—Of fact.

Did they state the system generally was a failure, or only that the system was so as laid in the Mile-End Road?—Both.

So far as the words were statements of fact, were they true?—Many untrue.

Was the defendant actuated by malice in saying the words or any of them?—Yes, except in the L.C.C. speeches.

Did the plaintiffs suffer any special damage?—Disagreement.

So far as the words were expressions of opinions, were they fair comment or facts truly stated?—Facts, not comment.

General damages?—£12,000, to be divided equally between the two plaintiffs.

Mr. Greer, K.C., applied for judgment for plaintiffs for £6,000 each.

His Lordship gave judgment in the terms applied for, and, on the application of Sir Edward Clarke, K.C., granted a stay of execution, in view of an appeal, on condition that security for £5,000 was lodged

Durtnall *v.* British Thomson-Houston Co.

On Monday, at the Patent Office, the Comptroller of Patents held an inquiry into the validity of a part of a patent which the British Thomson-Houston Co. are applying for, for a process of driving ships by electrical power transmission.

Mr. Durtnall asked the Comptroller to say that the respondents were using his combination, which he had previouly patented in 1905, without mentioning it in the specification.

Mr. A. W. Mathys appeared for the appellant, and Mr. Burgess represented the British Thomson-Houston Co.

Mr. Burgess held that the generator portion of the invention was not new, and he submitted that was the only thing Mr Durtnall was claiming.

The Comptroller said that so far as he could see the new combination which was claimed did not alter the effect of the old combination except in certain instances. What the new invention did was to add a third element to the combination in the form of a low-pressure turbine, which in certain contingencies gave extra power and force. He was not convinced that it was a new invention—it was merely the addition of a new element.

Mr. Burgess said his case was that the whole formed a new combination. They did not claim anything that was in the appellant's specification, and they did not need it. The system to a certain extent was similar, but the appellant's patent was entirely limited to ships' propulsion. His company were attacking a slightly different problem.

Mr. Mathys, for the appellant, said that if they could not get a specific reference in the patent, they wanted a general disclaimer of their combination. They claimed to have put this particular combination on record for the first time either on a vehicle or in a boat, and in their description they gave some very important infor-

mation with regard to putting it into practice. Under one condition of service, they said that the British Thomson-Houston Co. must use their combination, or if they did not, it would not be of any use for large powers.

The Comptroller said it was quite clear that the patents were different. That of the appellant's had nothing to do with low-pressure turbines. He asked Mr. Mathys whether he claimed that even although the combinations differed, or if the respondents employed one combination and added to it, they ought to say so.

Mr. Mathys replied that that was his contention.

The Comptroller said that at present his view was that it would be rather difficult to justify the concession of specific reference, but he would not absolutely say that he would not admit the claim. He would consider that question, and also the further one as to whether in the public interest there ought not to be some kind of disclaimer with regard to the appellant's patent.

Lane and Others *v.* Holden.

In the Chancery Division on Friday, December 2nd, before Mr. Justice Eve, Mr. Lane and other residents of Station Road, Thetford, Norfolk, claimed an interlocutory injunction against Mr. Holden, coffin maker, of the same street, to restrain him from committing a nuisance which they alleged was caused by noise emanating from defendant's machinery—viz., an electrically-driven circular saw and planing machine used in the course of his coffin-making business. The mill, they said, made an unbearable noise, and affidavits were read made by residents, who described it as an "unearthly noise" and a "jolly nuisance."

Mr. P. O. Lawrence, K.C., for the plaintiffs, said that the mill started at six o'clock in the morning, and ran continuously until about 3.30 in the afternoon.

Mr. Lane described the noise as "weird, startling and howling," and produced a state of "nervous tension."

Defendant denied the nuisance, and Mr. Clayton, K.C., on his behalf, read affidavits by various persons declaring that the mill was not so noisy as to be a nuisance, some witnesses describing it as "almost soothing," and "like the humming of a bee."

His Lordship refused to grant the interim injunction.

Julius Grevener *v.* Ellis & Son.

In the Shoreditch County Court, on Friday, before his Honour Judge Smyley, K.C., Julius Grevener, trading as Messrs. J. & H. Grevener, sued Messrs. Ellis & Son, of 96, Ironmonger Row, St. Luke's, electrical engineers, to recover £93 for electrical goods supplied. There was a counterclaim for financial support in a banking account of the Electro-Motor and Dynamo Co. for about 17 months, with a total turnover of £5,500, including bank charges, stamps, messenger's time and out-of-pocket expenses, £100; commission on introducing customers, £30, totalling £130. It appeared that in 1903 the defendant started placing orders with the Electro-Motor and Dynamo Co., of which Mr. E. B. Haertet was the proprietor. A verdict was given for the plaintiffs on the claim and counterclaim.

Judgment was entered accordingly, with costs.

Impregnated Telegraph Poles.—The *Electrical World* quotes some observations by Mr. K. Havelik, of Brünn, upon the frequent occurrence of the so-called house fungus (*Merulius lacrimans*) on telegraph poles impregnated with sulphate of copper, in the Province of Moravia. The poles were characterised by a sort of dado on the surface of the underground portion, such as one sees on all wood which has been injured by this fungus. On digging up the poles there was noticed an unpleasant fungus odour. This fungus was found wherever the poles were subjected to alternations of dryness and dampness, no matter what the character of the soil in which the poles stood. The life of poles attacked by the *Merulius lacrimans* is from two to fourteen years; where there is sudden alternation of dampness and dryness the pole rots away sooner. The formation of the *Hyphen* can also be observed. The thread-like germs of this fungus always lie in the lengthwise cracks of the wood, and are often quite deep. The more quickly the earth about the pole dries the larger are the threads, but the *Hyphen* itself is seldom to be found here. Where the earth dries more slowly, there are formed either weaker threads or none at all. The *Hyphen* usually branch out all around the pole. In order to counteract the influence of the house fungus the Austrian Telegraph Department has introduced impregnation with tar, which is regarded as a sure preventive of the *Merulius*.

The Imperial German Postal Department has recently published statistics concerning the life of telegraph poles. The average life of the poles was as follows for different impregnating materials:—Zinc chloride, 12 years; copper sulphate (blue vitriol), 14 years; corrosive sublimate, 17 years; tar oil, 22 years. The annual cost per cubic metre treated and delivered was as follows for the several impregnating materials:—Zinc chloride, 4 marks; copper sulphate, 3.50 marks; corrosive sublimate, 3.10 marks; tar oil, 2.80 marks. These figures show that impregnation with tar oil paid the best, that with corrosive sublimate the next best, and that with zinc chloride the least.

PROCEEDINGS OF INSTITUTIONS.

Street Lighting by Modern Electric Lamps.

By H. T. Harrison.

(Institution of Electrical Engineers, Manchester Section; *Discussion on paper read November 22nd*, 1910.)

Mr. S. L. Pearce (Manchester) said he was almost entirely in agreement with the whole of the subject matter presented by the author. It was too often the case that engineers were not allowed to choose the best positions for their lamps; for example, lamps had to be placed at street corners in order to allow for some illumination in the side streets, and in this case the illumination of the main thoroughfare became uneven if the lamps were of uniform candle-power. The advisability of having two Osram lamps in series in the lanterns seemed a little doubtful, as the failure of one lamp sufficed to put the whole lantern in darkness. Special precautions had been taken at Marylebone to preserve the lamps by the adoption of anti-vibration suspensions, and it appeared that with such precautions, ordinary 230-volt lamps could have been employed in parallel. Those who had seen the Marylebone lighting would no doubt agree that the effect was excellent. The question of the treatment of charges in Marylebone was not quite clear. The paper certainly read as if the Marylebone authorities had settled in their minds on a lump sum for the whole contract. Anyone who had tested modern flame lamps knew that the distribution was very unsatisfactory. The base of the lamp-post stood in a brilliant glare, and as the distance from the post increased, a very rapid diminution in illumination took place. He hoped that lamp makers would turn their attention to this most important point, with a view to the design of a correct globe. There was no doubt that the adoption of the inner dioptric globe was a great advance; the effective candle-power was increased, as pointed out in the paper, but two other important advantages were not mentioned by the author. More efficient ventilation was obtained, which meant the avoidance of a great deal of silting up on the bottom of the globe; carbon deposit was also avoided, so eliminating the loss of a large percentage of light. The third point was the prevention of the etching of the outer globe, which went on during burning hours. In Manchester, after using a certain type of lamp for about 12 months, 20 per cent. of the light was lost owing to the globe etching. The high-pressure gas lamps referred to were apparently of the same type as the 1,500-c.p. Keith lamps which had been erected in Piccadilly, Manchester. These lamps had been tested by photometer, and showed a maximum candle-power of about 1,260 at 30°. Apparently, from the figures obtained, the water pressure of 80 in. had not been maintained. Probably the gas engineers found that the high-pressure had a very destructive effect upon the mantles. There appeared to be a good deal of ground for believing that the gas consumption was in excess of that guaranteed by the makers, viz., 25 cb. ft. per hour, and the figures quoted in the paper, viz., 30 to 34 cb. ft. per hour, were probably nearer the mark. In connection with high-pressure gas mantles, there appeared to be a shrinkage amounting sometimes to 1 in. Would the short mantles give the same candle-power as the longer ones? Apart from fair wear and tear affecting the life of mantles, the damage caused by vibration and so forth, seriously shortened the economical life of the mantle and diminished its light-giving properties. It was to be gathered from the author's remarks that only two types of lamps were available for street lighting nowadays, viz., flame arcs and tungsten groups. There was no reference to the single-enclosure lamps, and this was, perhaps, a little extraordinary, in view of Mr. Harrison's remarks in his 1905 paper. Mr. Pearce fully endorsed the author's opinion as to the value of street lighting as a demand having a high load factor, but he did not go so far as to say that such a demand was superior to a motor load. It might be of interest to know that in Manchester an inclusive price of 1¼d. per unit was obtained, including capital charges and maintenance as well as current. The curves issued by manufacturers were probably substantially higher than were obtained in actual practice. The curve given for the tungsten lamps was remarkable and quite ideal.

Mr. W. W. Angus (Eccles) said that in Eccles about 200 posts were each fitted with a 55-watt 100-volt tungsten lamp in a well-glass fitting, with inverted reflector, mounted upon a swan-neck bracket. The approximate cost of the post, fitting and lamp erected, was £2 12s., and the approximate cost of the service, including tee joint, was £1 5s. 6d. The general public were well satisfied with the lighting result, as compared with the incandescent gas which the tungsten lamps had replaced. The cost of lighting main thoroughfares and side streets, as given in the paper, was much higher than small towns could afford. In Eccles the number of posts per mile in side streets was 40, against 65 mentioned in the paper, the cost per mile (Eccles) being, approximately, £100 per annum. A price of £2 8s. 6d. per post per annum was obtained, and this included electrical energy, lamps, renewals and attendance. This sum was based on a cost of 1·92d. per B. of T. unit, and it also provided for four lamp renewals, the average life of a lamp being assumed as 1,000 hours. Actual results had shown the average life of the tungsten lamp to be over 2,000 hours. The number of hours burning per annum was approximately 3,800, which meant a lamp renewal of a little over 1½ lamps per post per annum. The price of £2 8s. 6d. could therefore be reduced. Capital charges did not enter into the question, because the district fund paid for the cost of the services, fittings and posts.

Mr. A. G. Cooper (Colne) said he had only half-a-dozen arc lamps, from which he derived no revenue at all; the gas department gave the public lighting gratis, and, of course, the electricity

department had to follow suit. Regarding single-enclosed arc lamps, the town of Colne was very high (600 ft. above sea level), and to this fact he attributed the difficulty in making the carbons burn anything like the stated hours which enclosed arc lamps were expected to give. It was stated that single-enclosure twin-carbon lamps would give 70 to 80 hours, but he had been able to obtain a life of only 50 hours.

MR. J. FRITH asked the author how the various types of lamps were affected by fog. In the case of motor-cars having powerful projectors near the ground, their illumination was considered sufficient for purposes of viewing objects in the street, but they gave no horizontal illumination at all.

MR. O. MOON (General Electric Co.) considered that since the advent of tungsten lamps, electrically-lighted side streets competed easily with those lighted by gas. Time and statistics from over 50 towns had shown that tungsten lamps had an average life of over 2,000 burning hours. These statistics showed beyond doubt that small units for side street lighting were now successfully established.

MR. J. S. PECK (chairman) said, regarding minimum illumination, that he had worked out some of the figures given in the paper, and found that the value was from one source only, whereas there were really two sources, one at each end. The question of globes on flame lamps was one of very great interest. A case in mind was that of two lamps, one with a clear globe, and the other an opalescent globe; owing to the fact that the opalescent globe looked like a ball of fire, it was selected as the best light-giving lamp. Reference was made in the paper to gas costing 7d. per 1,000 cb. ft. in order to produce the same light for an equal cost. Other figures were given in the paper regarding the amount of gas required for smaller incandescent burners, and seemed to show that it was necessary to sell gas at 10d. per 1,000 cb. ft. in order to compete, in that type of mantle, with the tungsten lamp consuming energy at 1·4d. per unit. This showed the almost hopeless position of gas in competing even for small units. It was very difficult to find a means of compariug illumination. It was stated that "It is interesting to note that when these roads were lighted by gas mantles, the minimum direct illumination was 0·0036, and thus the illumination is now about seven times as high, the cost being about three times greater." If three times as many gas mantles were installed so as to bring the case equal, there would be nine times the illumination.

MR. F. SELLS (General Electric Co.) said that very few people in the Manchester district had to deal with street lighting expenditures such as £8,000. It would be most interesting to have the author's experience regarding street lighting on a small and inexpensive scale. The author had dealt chiefly with street lighting which had been done by converting arc lighting into tungsten, but it would be of interest to have figures relating to the conversion of side-street lighting from gas to electricity. The speaker's experience was that whilst low-voltage tungsten lamps might have a longer life than those of high voltage, the series lamps would not have so long a life as the parallel lamps, the most apparent reason being the difficulty in matching the series numbers.

MR. H. C. CREWS said the author's paper marked the end of the rule of thumb era in street lighting; in future this would be done on scientific lines. The curve given for the low-pressure inverted gas mantle might be corrected by means of a suitable shade or reflector in the same way as the electric lamps. On the other hand, the falling-off in candle-power of all gas mantles was a serious depreciation, which gas people would not admit. Metal lamps were not liable to any such serious depreciation, and electrical men had much to gain in this respect.

MR. HARRISON, in reply, said that when the work in Marylebone was carried out, the smallest 240-volt tungsten lamp available took 63 watts, two of which have been too expensive a unit for the small streets; hence two 35-watt lamps were used in series, which gave a much better result than a single lamp, and resulted in very little extra cost in maintenance. The peculiar figure of 1·42d. per unit for cost of energy was brought about by the addition of certain loan repayment charges, viz., the cost of fittings over three years and services over five years; 1d. per unit would easily cover the cost of services, provided the repayments were spread over a longer period. The form of profile curve of candle-power of various inverted gas mantles depended purely on the length of mantle, which in its turn depended on the pressure and quantity of gas supplied; the higher the pressure the longer the mantle, which resulted in a better distribution for street lighting. He omitted enclosed arc lamps from his comparison because up to the present none had been made with correct light distribution curves; thus their efficiency for the purpose was very low. He quite agreed that horizontal illumination was not everything to be considered, but as it embodied all the other factors, it was the most convenient unit for comparison purposes. Fog penetration depended largely on the amount of red rays present, and therefore generally favoured incandescent electric lamps. Replying to Mr. Moon, the 50 towns mentioned as giving a total average of 2,000 hours' life for tungsten lamps must either include a large number of 100-volt towns, or perhaps the General Electric Co. was very generous over premature failures, thus they were not included in computing the average. He thought the average of all the towns he was interested in would be nearer 1,400 hours per lamp. The life of the series lamps in Marylebone had come out even longer than that of the small candle-power high-voltage lamps. This also applied to other places where it had been necessary to do the same thing. Care was taken over the pairing, but in one town where no trouble was taken, the results were still good. The cut-outs mentioned in the paper for use with series lamps were of the same construction as those used in Nernst lamps for cutting out the heater, and took less than two watts. The cost of gas for the gas lamps at Marylebone would be about 1s. 10d. per 1,000 cb. ft. The cost of lamp renewals was very often less than the cost of mantle renewals when the cost of labour was included.

Electric Winders.

A DISCUSSION on the above subject took place on November 21st at the NEWCASTLE SECTION OF THE INSTITUTION OF ELECTRICAL ENGINEERS; it was opened by MR. J. G. WILSON, whose remarks are abstracted below:—

The problem presented by the electric winder, from the electrical engineer's point of view, is related to the problem of haulage, and more distantly to some of the problems of electric traction and of the electric driving of rolling mills, but differs radically from all other applications of electricity to mining work. The power is only required intermittently. The masses moved are stopped and restarted once or twice a minute—more or less according to whether the shaft is a deep or shallow one—and although the net power exerted in raising the coal is comparatively moderate, the power required during acceleration is often twice and sometimes three times as great, due chiefly to the fact that the mass set in motion is from 10 to 20 times as great as that of the coal lifted at each wind.

The extent to which this acceleration adds to the power which has to be exerted by the winding engine is not always fully realised. For instance, the load of coal lifted at each wind by the electrical winding engine recently installed in the Harton Colliery, in this district, is four tons, and the power required to raise this weight, including friction, windage, &c., at full speed is only a little over 700 H.P., whereas the maximum power exerted by the motor in acceleration is 1,500 H.P. The reason for this large difference of nearly 800 H.P. is clearer when it is remembered that the total mass moved is 72 tons and the rate of acceleration is over 3 ft. per second per second. Some electric winders work with speeds nearly double and accelerations half as big again as those employed at the Harton Colliery.

The depth of shaft and the amount of coal that can be lifted at each wind are, in general, fixed quantities; the frequency, and therefore the speed of winding, are variables which can and should be chosen with a view to economy, and it is often overlooked that there is for each case a speed of operation above which winding is less economical, and above which the plant would be excessive in size and cost.

As a consequence of the intermittent application of power and the excessive power at starting, the average power exerted by a winding engine is small compared to its maximum power and small in proportion to the size and cost of the plant installed. Taken on the basis of maximum power exerted, about one-half of the total power employed on collieries in this district is in winding alone, and the rest is for other purposes. On the other hand, if we consider what the annual consumption of energy would be on the supposition that the whole of the colliery power work, including winding, was performed electrically, not more than a quarter of the units would be used in winding and three-quarters would be for other purposes. In other words, the load factor, or ratio of average to maximum power, is low.

The annual saving effected by electric winding as compared with steam is proportionate not to the maximum power exerted, but to the power averaged over the whole year, whereas the capital expenditure involved by the equipment is much more nearly proportionate to the maximum power exerted. As the capital expenditure is the only argument against electric winding, this explains why the conversion of winding engines to electric working proceeds less rapidly than that of other colliery work. There have recently been changes to remove this obstacle.

Another distinguishing feature of electric winding is that it is not merely a matter of starting and stopping with extreme rapidity, but greater accuracy and perfect control are also required, and it is of the utmost importance to have reliable automatic devices for preventing overwinding and assuring safety in the event of failure of the electric supply, and so on.

A three-phase induction motor lends itself less readily than a direct-current one to efficient starting and speed control. The start is wasteful in power, and involves a large controller having some mechanical complication. The power factor of the current taken at starting is, moreover, low—especially if the motor is direct coupled—thus taxing the generating plant severely, and causing fluctuations in the pressure of supply to other services. The main advantage is that the motor is of the same ruggedly simple type, as has been found best for all other colliery work, and with the exception of a relay motor is the only electrical machinery involved.

The continuous-current winding motor does not receive its current direct from the main source of supply, but through some form of converter, usually a motor-generator, of which the motor may be of any type to suit the main source of supply. The generator, which I shall refer to as the regulating generator, supplies direct current to the winding motor at a widely varying pressure. The chief advantages of this method are:—

1. The large rheostatic loss is avoided.

2. A finely graduated control over the whole range of speed is provided and easily effected directly by the operator's hand without the complication of a relay.

3. Automatic devices for preventing over-winding are more easily applied to the field circuit of the regulating generator than to the main power circuit, as in the three-phase motor. Moreover, by special arrangements of the windings on the regulating generator, the control can, if desired, be rendered absolutely fool-proof, no matter how careless the operator.

The disadvantages, on the other hand, are, first, that in place of

only one machine three are required, each of which handles the whole of the load, namely, the winding motor, the regulating generator and the motor on the supply. This not only runs up the first cost, but in operation involves losses in the motor-generator and involves also a slight additional risk of stoppage due to accident.

The regulating generator is required to give current during acceleration some 100 per cent. in excess of its mean load, and at the moment of starting the cage it gives this large current at only about one-eighth of the full voltage, the whole reduction being effected by weakening the field, as the generator itself runs at full speed all the time. Generators as designed some years ago would be totally unable to commutate satisfactorily under these conditions, and it is only by a more rigid application of the principles of design, and more especially by the introduction of commutating poles, that these generators are successful.

Winders of quite small size should, in my opinion, be of three-phase type, unless a direct-current system of supply has already been installed at the colliery for quite independent reasons. It is only on larger sizes, say, from 200 H.P. upwards, that the question of the continuous-current winder has considerable claims, and then it has to be settled with reference to the special features of each case. First cost is also a consideration, as the direct-currect system is more costly than the other.

The next alternative to be considered when an electric winder is installed, is whether a fly-wheel for the storage of energy need be added. This is possible with either a three-phase or a direct-current winder.

The starting point of the question is really the source of supply. If this be a local one, that is to say, a comparatively small generating plant supplying one colliery or a small group of collieries, and if the winder be large, there can be no question that the extra cost and complication of a fly-wheel is justified. As already mentioned, it frequently happens that the peak power during acceleration is double or more the average power required, and it is easy to show that the cost of the extra generating plant required to supply this peak will exceed the extra cost of supplying the peak power from the fly-wheel.

If, on the other hand, the supply is from some central source on a large scale, the necessity for a fly-wheel is a subject for much closer investigation and for collaboration between the colliery engineer and the company furnishing the supply. The question requires very considerable attention in each case, so that the extra cost of the fly-wheel and of the regulating device required with it, are not incurred unnecessarily.

If the winding motor is three-phase, it is connected direct to the supply and controlled by a liquid rheostat, and the fly-wheel plant is merely an adjunct, not essential to the working of the winding motor, but an assistance to the generating plant. The fly-wheel plant then consists of a rotary converter connected to the supply, and a fly-wheel connected to a direct-current dynamo. When the winding motor is at rest the rotary converter receives current from the supply and passes it on as direct current to the machine connected to the fly-wheel, which speeds up and stores energy. While the winding motor is accelerating, the fly-wheel slows down, and the machine connected with it generates direct current, which passes through the rotary converter and reaches the winding motor as three-phase current in parallel with the main supply. The distinguishing feature of the system is that winding can be continued, at any rate at a reduced speed, if the fly-wheel set breaks down.

If, on the other hand, the winding motor is a direct-current one, the fly-wheel arrangement usually consists merely of the addition of the fly-wheel to the motor-generator already described under the Ward-Leonard control, the fly-wheel set then being, of course, essential to working.

The speeding-up and slowing-down of the fly-wheel is in this case effected by a resistance in circuit with the motor driving it, which automatically keeps the intake from the supply approximately constant.

Next there is the question of geared *versus* direct drive motors, and I hope that users who have had experience with the double helical machine-cut gearing which has only recently come into use for the heavier drives, will give their opinion of it. The high efficiencies of 98 and even 99 per cent. are, I believe, quite established—in fact, the overall efficiency of a geared motor is not less than that of a direct connected one—and the question is really a matter of durability of the gearing, which also ought to be satisfactory even where the power to be dealt with is of the order of 1,000 H.P. The first cost even with the gearing, is much less, and the facility for handling in case repairs have to be made is much greater. Moreover, in cases where it is decided to provide a complete spare motor, the substitution of the spare in case of accident is a very much simpler matter than in the case of a direct-drive motor.

There is another question I hope to hear dealt with this evening, and that is the reason why the substitution of the Koepe pulley or some other similar device for the ordinary winding drum has not been more usual. A very large proportion, in fact with deep shafts nearly half, the total mass to be accelerated, is on the drum itself, and we have already seen how formidable the acceleration power is where the conditions are severe. Doing away with the heavy drum, and substituting a pulley merely carrying one convolution of the rope, and therefore weighing only a small fraction of the weight of the drum, very largely obviates this difficulty, but these pulleys have not been used in this country.

As the Koepe pulley practically involves the better balancing of the tension in the ropes connected to the cages by means of a balance rope, any objection to the use of the balance rope is an objection also to the use of the Koepe pulley. But both have been frequently used on the Continent. Of course, the balance rope has also been used in this country without a Koepe pulley, and is in many cases of deep shafts most useful in keeping down the maximum power and the cost of the winder. Its advisability, or otherwise, forms a separate question for discussion.

An alternative to a balance rope is coning a portion of the drum so as to commence each wind with a smaller radius, and, therefore, a greater leverage. This, although at first sight attractive, is usually of doubtful utility, and adds objectionably to the weight of the drum.

There is, lastly, the question which is really, of course, by far the most important one of all, as to whether electric winding can be justified on economical grounds, as compared with steam winding. It appears to me to be a question which can only be dealt with in specific cases, and is not capable of generalisation, because the determining factors vary over such wide limits. These are :—

1. The value at the particular pit of the coal available for power purposes. One extreme case, not uncommon, is the presence of sufficient unsaleable coal, which is yet of a quality possible for use under the colliery's boilers—in this case it must not be forgotten that when everything is taken into consideration, the cost of burning such coal may be considerable—and at the other extreme, there is the case of an iron or other mine which has to pay full price for its coal. Another case is that of a coking colliery producing waste heat. In this latter case, however, the provision of steam for winding engines is a most uneconomical way of utilising such waste heat, which, in this district, is more remuneratively disposed of to a power company, who can utilise it on a better load factor.

2. Another variable factor is, of course, the cost of energy, whether bought from the power company or made on the spot, and the difference between these two cases is, of course, very considerable.

Apart from the extra capital charges involved by small units and spare plant, a first-class central station will use per unit only a small proportion of the coal required by even a good private plant.

3. Another factor is the length of the working day. The Eight Hours Bill has had the effect of lengthening the working hours at many pits from 10 to 16, and this has a very important influence in favour of the economy of winding electrically. The extra first cost of the electric plant is the principal, in fact the only, argument against it, and the longer the working day the greater saving will it effect for a given cost.

In comparing the working cost of steam and electric winders, one important point is sometimes overlooked ; the electric winder is much easier to handle and much less at the mercy of an unskilful operator.

Lastly, there is the alternative method of effecting a saving, namely, by retaining the steam winder and putting down exhaust-steam generating plant for supplying the rest of the power at the colliery.

Where cheap supply of power from a central source is not available, this is a reason for retaining steam winding which merits very careful consideration. Where a central supply does exist, the exhaust steam plant can be coupled up to it, and in this way the whole of the exhaust steam can be utilised, whether it happens to coincide in amount and load curve with the other power requirements of the colliery or not—in practice, of course, it never does. But the exhaust-steam plant involves an accumulator, and is costly in capital and up-keep, and it is not, in my opinion, the most economical way of dealing with the whole question when power can be bought cheaply for an electric winder.

I believe the latter to be the solution which will be gradually adopted in all such cases.

Mr. Clothier then read a communication from Mr. Gerald J. Hooghwinkel, the gist of which is given below :—

An opportunity to demonstrate the possibilities of electric winders was afforded him by one of the most progressive colliery managers in South Wales, and the results had not only fully substantiated the claims he put forward four years ago, but had especially refuted those vague statements, unsupported by any proofs, of unreliability and heavy repairs, which were then made. Many colliery managers and engineers had since been converted to electric winding in both North and South Wales, where electric winders of large capacity were being erected. The latest conversions included the general manager of one of the largest South Wales colliery combinations. South Africa became converted through the efforts of Continental manufacturing interests, and the other mining fields in all parts of the world were following slowly, but surely. Everything pointed to the increasingly quick adoption of electric winding at home. The results obtained at the Great Western Colliery, with which he was connected, had been fully up to the expectations of the directors and management, and this was still the only winding engine of fair size in this country which had been regularly at work during a period of two years. There had been no stoppages due to breakdown of the winder, and when at one time some small trouble was experienced with the fly-wheel set, this was promptly shut down, and winding was continued without the equalising machinery. Ever since then the fly-wheel set had been used only occasionally, although the current was taken from a power company on the basis of a fixed payment on the maximum demand for each month plus a small charge per unit, the whole charge amounting to about ½d. per unit. The system employed was the Westinghouse equaliser-in-parallel system with a three-phase winding motor ; the "Ilgner" was an equaliser-in-series system. This parallel system were lower in first cost, and could be shut down without stopping the main winder, but the equalising and speed regulation were not quite as close as with the Ilgner. Still, the manager of the power company in question stated, during the discussion of the writer's paper in Cardiff, that when the winder was at work it was not possible to distinguish

any fluctuations of greater magnitude than those ordinarily expected. The cost per ton of coal wound was under 2d., including all capital charges, the load factor of the engine being about 12 per cent. to 15 per cent. It was found that the stopping of the equaliser meant a great saving in power all round, a possibility which the Ilgner winder did not permit. The abolition of the heavy running charges of this equalising plant would do much to popularise the electric winder still further.

Three-phase winders with liquid controlling gear could be installed in many cases without equalisers. The special features of large steam turbine sets had, however, suggested a solution which the writer worked out a couple of years ago, and which had since been independently introduced by Messrs. Brown, Boveri & Co., with one difference. The special features of the large steam turbine, especially of certain makes of the impulse type, were easy and close regulation, great reliability, once properly installed, and still greater overload capacity. The idea was, of course, to work the prime mover at the best load factor, and this was difficult if the colliery power station was small, and the winding motor of relatively large capacity. It was also often desirable, even where power was taken from a power company, to have an independent supply at the colliery in case of breakdown of cables or long transmissions. In order to reduce the cost of such a separate colliery power station in case supply from a power company was also available, the writer suggested a single turbine set of such capacity as to supply the average power for the winding motor, and the average power for the other electrical plant at the colliery. The turbine drove a direct-current generator for the winding motor and a three-phase generator for the colliery supply. The direct-current generator drove the winding motor on the Ward-Leonard system, the boilers acted as a storage set, and the three-phase generator gave a steadying load for the turbine.

Messrs. Brown, Boveri & Co. had installed a plant lifting 7½ tons of coal from about 800 yards' depth 30 times per hour at a colliery in Silesia, and this installation had given every satisfaction and had filled the most sanguine expectations.

The difference between his suggestions and Messrs. Brown, Boveri's, was that the latter used a synchronous generator, while he suggested a generator of the asynchronous type. The advantages of this system were briefly as follows :—(1) Lower first cost of the electrical plant; (2) less machinery; (3) less power and better efficiency of the complete installation; (4) lower repair and maintenance charges; (5) lower costs for buildings, foundations, &c.

A complete test at the colliery had proved Claim 3 to be correct. The generators gave 1,740 KW. and 625 KW. respectively. The capacity of the winding motor varied between 565 and 1,400 H.P., and the corresponding generator figures were 475 and 1,240 KW. The total cost without boilers was £15,000, but the installation was the first of its kind, and could have been somewhat reduced in cost by adopting a motor of smaller diameter.

The results of exhaustive trials gave with about 115 tons of coal per hour, or half the useful load for which the engine was designed, 15·5 lb. of steam per unit and 17 lb. of steam per useful shaft horse-power. The regulation of the turbine was so good that the speed variation was less than 2 per cent. from full load positive to full load negative on the winding generator, and the three-phase generator could not be thrown out of step.

He had recently had an opportunity of calculating the figures for a winding plant of about double the capacity of that described above, for the same depth, and the figures based on actual prices compared as follows :—

	Cost of installation complete.	Cost per ton of coal wound.
Ilgner equaliser with energy at ½d. per unit	£19,000	2·7d.
Direct turbine drive	£32,000	1·7d.

The cost per unit for the colliery supply came to under a farthing, so that the difference under this head had to be added to the saving per ton under "winding." He would urge a careful consideration of the various systems in each particular case by specialists, in the interests both of the colliery and of the manufacturer.

MR. W. C. MOUNTAIN said that the type of winder to be installed depended entirely upon the local conditions. If a supply company's mains were handy and a supply could be had at a very low figure, then electrical winding was worth considering, but in most collieries as at present existing a large amount of exhaust steam was available, and if the supply of this was constant enough, it was advisable to use it in exhaust turbo-sets to supply power to the pit. He knew of cases where electricity was being generated thus, at ·15d. per unit, including all charges. This system undoubtedly had a very large future. The winder was the life and soul of any colliery, and considering that many steam winders had been at work 30, and in some cases even 45 years, without costing more than a nominal amount for repairs, he did not think the electric winders could compete on the score of reliability. Electrical gear was comparatively delicate and complicated, the simplest type being the large low-speed three-phase motor, the winding of which might well consist simply of copper bars in mica tubes, thus making repairs as simple as possible. In his opinion, the Ilgner system introduced too many links, any one of which was liable to go wrong, and the possibility of laying a pit idle for weeks for repairs was a strong argument against it. 2d. per ton had been quoted for electrical winding, but this could not compare with some thoroughly reliable figures he got out five years ago, which showed values as low as 5s. per 100 tons with steam winding, the very highest being 16s. per 100 tons. Even better results could be got at the present day. He strongly urged the advocates of electrical winding to come forward with definite figures. The Westinghouse system had the great advantage that winding could be continued even if the balancer broke down. With regard to helical gears, he knew of some, running in oil, which had been transmitting 700 H.P. for two years, without showing any signs of wear. The Koepe pulley had been mentioned, but this had the disadvantage that if the rope broke both cages fell to the bottom. He knew of cases where 15 per cent. in coal consumption had been saved by using balance ropes.

MR. WOODYATH (Siemens Bros., London) admitted that the capital cost of electric winders was comparatively high, but the results were so satisfactory that users never reverted to steam. Electric winders were rapidly coming into use on the Continent and in South Africa. He might mention that the Ilgner patent for winders was quite distinct from that for rolling mills, which had been held to be invalid. His firm had some large winders in hand at Stafford, one of them taking a peak load of 9,000 H.P. Every attention had been paid to the provision of safety appliances, and even an unskilled labourer could not do any damage. The Koepe pulley was used almost exclusively on the Continent, but it had three objections—viz., the use of a balance rope was essential, both cages went to the bottom if the rope broke, and it was not suitable for high speeds.

DR. ROSENBERG (British Westinghouse Co.) said that electric winding was becoming cheaper owing to the use of large generating units. His firm had a number of large winders in hand, amongst them being four of 1,600 H.P. at 98 R.P.M. For deep shafts direct-coupled motors were most successful, but his firm had all sorts, except the Ilgner, in hand for South Africa. There was no inducement to flatten the load curve there, as they paid on a flat rate. His firm was at present installing a winder with a Koepe pulley to lift 900 tons per day out of an 800-ft. shaft, the whole of the gear being in a tower at the pit mouth.

MR. G. STONEY (C. A. Parsons & Co.) said that the fluctuations due to a 1,500-KW. winder would certainly show even on a system having a generator capacity of 30,000 KW.

His experience of helical gear had been very satisfactory, as the *Vespasian*, which was fitted with such gear having a ratio of 1,500/85, had made 15 trips to Rotterdam without the gear showing the slightest sign of wear. He considered that helical gear would help to solve many transmission problems.

The discussion was then adjourned for a fortnight.

Care of Mining Plant.

AT a meeting of the ASSOCIATION OF MINING ELECTRICAL ENGINEERS (East of Scotland Branch) on Friday last, at Dumfermline, a paper was submitted on "Inspection and Repair of Electrical Plant Underground," by Mr. R. R. Smith, who maintained that it was necessary for a competent person in charge of plant to inspect it daily, and it was important that he should be very observant. A thorough examination of the parts in detail was usually most necessary. At his colliery two sets of switches were examined and adjusted each day. That meant that each switch was examined once every fourteen days, and this proved ample. Should the oil show signs of carbonisation, a sample was taken and tested, new oil being sent down if necessary. Every week a motor was opened out by men from the surface, cleaned, and the clearances taken. As far as possible insulation tests were taken monthly, and if these came below a certain minimum resistance, then each individual part was tested until the fault was localised. The insulation tests were recorded in a book, it being stated which cables, switches, &c., were taken together, and if the insulation of any part was found to be low, a note to that effect was made.

MR. R. W. PETERS thought that manufacturers should devote more attention to insulation. With fairly good insulation any machine ought to be able to withstand a temporary overload after, say, two days idleness. That, however, was not quite their experience on Monday mornings when they restarted plant which had been at a standstill during the week-end.

MR. H. GORDON FRASER said that the matter of oil leaking from bearings was one to which the manufacturers must also give attention. Its continuance, he felt, would periodically affect windings. It was not always fair to blame the manufacturer when oil interfered with the windings, because a number of motormen did not understand the question of oiling at all.

MR. WILLIS gave it as his experience that in several instances where manufacturers were blamed they were not at fault at all. Bad attention was generally the real source of the trouble.

MR. WALKER thought that there was something more than carelessness or inattention to the oil at the root of the trouble. Others took part in the discussion.

MR. SMITH, in reply, said there was no doubt the makers were to blame in many instances.

Institution of Electrical Engineers (Yorkshire Local Section).

ON November 16th MR. T. HARDING CHURTON delivered his inaugural address as chairman of the Section, at Leeds. He announced that a Committee had been formed for the purpose of obtaining particulars respecting the operation of textile factories by electric motors, with a view to proving the advantages to be gained by the adoption of electric driving. Englishmen, he thought, were not so enterprising in advertising their productions or commodities as some other nations—especially the Americans

and Germans—and they might with advantage emulate their business methods in some respects, in order to make more widely and fully known the value of that which they had to offer. In that Local Section they might well demonstrate the advantages of electricity as applied to the iron and steel, engineering, mining, textile and clothing, leather and other industries that were largely carried on in their midst, inviting representatives of those industries to take part in their discussions upon papers relating to the particular industries in which they were severally engaged.

The interests of the electrical industry might also be more completely watched by the influence that the Institution might bring to bear upon legislation and Government regulations concerning it—pressing for the removal or revision of unnecessary restrictions and rules, and for the concession of reasonable facilities necessary for the development of electricity for the public good.

During the past few years the electrical manufacturing business had not been in a flourishing condition, and the monotony of the reports of public companies had been somewhat depressing. In the keen competition to obtain orders, prices had been reduced and reduced, and profits had become microscopic in their proportions. And yet the business had been rapidly growing, the demand for electrical apparatus had continually increased. To what was this unsatisfactory state, commercially, to be attributed? He believed it was mainly due to the productive capacity of their factories exceeding the demand of the market open to them. In time supply and demand would tend to adjust themselves, and prices might then be expected to realise a reasonable profit; but the foreigner would then be tempted to compete and thus prevent any material improvement. So that, while prices were now kept low by *internal* competition, any material increase would, apparently—under existing fiscal conditions—be prevented by *external* competition.

It was an incontrovertible proposition that a manufacturer whose market was *more* restricted was—other things being equal—at a disadvantage as compared with one whose market was *less* restricted. And the German or American manufacturer, therefore, having the monopoly of their respective home markets, and equal terms with ourselves in our own, had a decided advantage in that respect. The preference that we had in certain colonies, welcome as that was, was quite inadequate to compensate for such unfavourable terms elsewhere. The result was that in this unequal contest with our foreign rivals we had to work harder and better in order to keep pace. The severity of competition had operated as a stimulus to increased effort in the direction of improvement and to economy with efficiency in design and manufacture. But so long as the same causes continued to operate, our task appeared likely to remain an up-hill one.

Referring to the improvement in design of electrical machinery, Mr. Churton said that the use of interpoles and increased ventilation had enabled the weight of D.C. generators and motors to be considerably reduced. The size and weight of A.C. motors and transformers had also been much reduced by the employment for the laminæ of a special steel alloy, due to Sir Robert Hadfield, of very high permeability, and by their being well ventilated. One effect of this reduction in the size of motors was that, being more dependent upon ventilation to carry off the heat generated, when they were totally enclosed the reduction in capacity on account of heating was more pronounced. In many instances motors might be run more efficiently and economically at a much higher temperature than was at present considered advisable were it not for the combustible nature of the insulating materials.

The subject of insulating materials was an important one, and one that afforded ample opportunity for research and experiment. They still wanted something that would stand higher temperatures without risk of burn-out, and that would last well.

Several causes had contributed to the general lowering of costs of production—which, in some branches of manufacture, had been very marked—in spite of a concurrent increase in prices of some of the chief materials; but no cause had contributed more, perhaps, to the reduction in cost than that which had become increasingly possible as the demand for electrical machinery had grown—the manufacture in quantities of stock parts, or of complete units, thus enabling both workmen and tools to be regularly engaged on the same work or class of work.

Thus there had been a marked tendency among manufacturing firms to specialise in certain lines, each developing their own standards or patterns, adopting certain varieties and sizes of their own selection, and manufacturing these in quantities to stock.

The Engineering Standards Committee in their published Report on Standards for Electrical Machinery, proposed that the rating of a motor for continuous work should be based upon its performauce for six hours. A small motor might attain maximum temperature rise in a few hours, while a larger machine might continue to get hotter for several hours longer, and though not too hot in six hours, might become too hot for safe working when run on "continuously." Would it not be much better to specify the ultimate temperature rise attained, irrespective of the time taken for the limit to be reached? The intermittent rating, it was proposed, should be based upon the performance for one hour continuously. The fallacy of such a system of rating had been frequently exposed. The proposed standards for B.H.P. and speed of motors would be of but little practical value.

The standardisation of voltage, and, in the case of alternating current, of numbers of phases and of frequencies—in order that the variety of electricity supply might be as small as possible—was greatly to be desired; the manufacturer of motors had, at present, to provide for a very great variety indeed.

The tendency in electrical manufacturing was to simplify the work of the workman, and to depend less upon his knowledge and skill, while of the managers, designers, administration and supervising staff, more skill and knowledge, greater ability and concentration of effort, were continually demanded.

With regard to the young workman, practically the only way to learn the work was by actual work in the shops. Whether he would be the gainer by attending evening classes depended upon the kind of work in question; the character and ability of the student; the character of the training he received; and, with regard to his prospect of advancement, upon the demand for the application of the additional skill or knowledge acquired.

In the performance of many operations, little or no knowledge beyond that gained from practice in the shop was likely to be of much practical assistance. To qualify for the position of foreman, not only was a thorough knowledge of the work necessary, but also personality. Energy, tactfulness, method, ability to control men and get the best work out of them, could not be acquired by attending classes, but the scientific principles could be learnt, and the course of his studies be guided. Special care should be taken to ensure that the training was appropriate to the work in view, and not "over the heads" of the students. It behoved every workman to know something more than was necessary to do just the work that he might, for the time being, be engaged upon, so that he might be able to adapt himself to such changes and developments as might take place. The Education Department in that city appointed an advisory committee consisting of manufacturers engaged in various industries, and others, with the object of conferring with the managers of the technical schools as to the courses of study and other cognate matters, and such co-operation must be mutually beneficial.

The training of men with a view to their becoming designers or managers should be much broader than that which was appropriate to the workman. Power of observation and of the grasping of problems, ability to combine ideas and to form new ones, such as originate improvements, inventions, new applications or adaptations, were called for. Neither the works course nor the college course could independently fit a student for any superior position, but both were equally essential.

Whatever might be the training, the British workman still maintained his position of superiority among the nations of the world.

Turning to the development of the electrical distribution of power as a means of conserving coal, the Chairman pointed out that the necessity for economising fuel must become increasingly important. The advantage of large size in steam sets was seen not only in increased economy in steam consumption, but also in other operating costs, and in building space, and they might confidently anticipate the adoption of much larger units than at present. At the Delray station of the Detroit Edison Co. (Michigan, U.S.A.) which he recently visited, there were several sets of 14,000 KW. capacity. The height of these sets was 37 ft., the turbine blade rings were 13 ft. in diameter, and the revolving field 9 ft. in diameter. The boilers were of the water-tube type, and one of the large ones would keep 8,000 KW. going. The day load of this station was about 22,000 KW., including street-car service. The economical generation of power thus secured, coupled with cheap and efficient distribution by means of high-tension overhead wires, enabled the power company to sell and deliver power at a cheaper rate than the consumer could generate it with relatively small plant, and a ready sale for the energy was thus assured. If the power company would have the large consumers as customers (especially those whose load factor was high—such, for example, as textile mills), they must adopt plant and economies quite beyond the reach of such consumers. Higher voltages of transmission would be necessary to reduce as much as possible the cost of distribution, and this presented no difficulty. Voltages of 40,000 or 50,000 would be quite practicable, and would probably be adopted in our longer-distance transmission and distribution schemes in the near future.

The public were becoming sensible of the advantages that the uses of electricity afforded, and a bold policy of progress in electric power supply would meet with its due reward.

In this connection, with regard to those electricity supply undertakings that were in the hands of municipalities, he thought it was the better policy vigorously to develop an undertaking in such a way as to enable it to turn out its product in the most efficient and economical manner, and thus to provide cheap power, than to apply surplus profits to the relief of rates—a penny-wise and pound-foolish policy.

The popularisation of electricity for power, heating, lighting and other purposes, would not merely economise coal and thus conserve our national resources, but would at the same time clear the land of the pall of smoke that hung over it. It was no idle dream, he thought, to look forward to a change in all this—and that in the not far-distant future.

Humphrey Pumps and Compressors.

By H. A. Humphrey, M.Inst.C.E.

On November 12th Mr. Humphrey read a paper before the Manchester Association of Engineers describing the latest developments in his system of pumping water by the direct action of exploding gases, described in a paper before the Institution of Mechanical Engineers last year. The system is defined by the author as follows:—"A method of raising or forcing liquid which consists in applying the energy of expansion of an ignited combustible mixture to one end of a column of liquid so as to propel the column along a discharge pipe, and to cause it to oscillate in the pipe under such conditions of energy of the moving liquid, that everything necessary for preparing for the next ignition is performed during one or more oscillations, and wholly or partly owing

to it or them." The simplest case of Humphrey pump is illustrated in fig. 1. Water has to be raised from supply tank S T to an elevated tank E T; C is the combustion chamber, W the water-valve box, V valves opening inwards, and D the discharge pipe. In the top of the combustion chamber are fitted an inlet-valve A and an exhaust valve E. A simple interlocking gear is arranged between these two valves, so that when valve A opens and closes it locks itself shut and releases the valve E, and when valve E opens and closes it locks itself shut and releases valve A; consequently each time the suction occurs in the chamber these valves

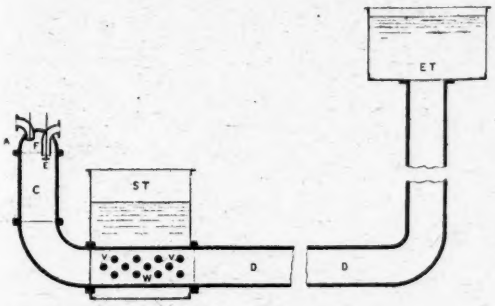


Fig. 1.

open in turn. Imagine a charge of gas and air to be compressed in the top of chamber C, and fired by a sparking plug which projects through the top casting. All the valves are shut when explosion occurs, and the increase in pressure drives the water downwards in the pump and sets the whole column of water in the discharge pipe in motion. The column of water attains kinetic energy while work is being done upon it by the expanding gases, so that when these gases reach atmospheric pressure the column of water may be moving with considerable velocity. The motion of this column of water cannot be suddenly arrested, hence the pressure in C tends to fall below that of the atmosphere, the exhaust valve E opens, and also the water valves V. Water rushes in through the water valves mostly to follow the moving column in pipe D, but partly to rise in chamber C in an effort to reach the same level inside the chamber as exists in the suction tank.

When the kinetic energy of the moving column has expended itself by forcing water into the high-level tank, it comes to rest, and there being nothing to prevent a return flow, the column starts to move back towards the pump, and gains velocity until the water reaches the level of the exhaust valve, which it shuts by impact. A certain quantity of burnt products is now imprisoned in the cushion space F, and the energy of the moving column is expended in compressing this gas cushion to a greater pressure than that due to the static head of the water in tank E T. Hence a second outward movement of the column results, and when the water reaches the level of valve E the pressure of the space F is again atmospheric, and further movement of the water opens valve A against a light spring and draws in a fresh charge of gas and air. If there were no friction the water would fall to the same level as that from which the last upward motion started, but the amount of combustible charge drawn in is slightly less than this movement would represent. Once more the column of water returns under the elevated tank pressure and compresses the charge of gas and air, which is then ignited to start a fresh cycle of operations.

The pumps may discharge into an air vessel, or an open standpipe, if desired to give a continuous flow.

No simple means of indicating the work done by the expanding gases has been found, but indicator cards giving pressures on a time basis are given in fig. 2, from a 45-B.H.P. four-stroke pump, lifting 39·4 ft. head, with town gas.

The figures relating to this card are :—

Compression pressure at ignition	...	56·5 lb. per sq. in.
Explosion pressure	... ...	163 lb. „
Cushion pressure	... ...	185 lb. „

The pump was delivering 306 gallons per working stroke.

The card may be explained as follows :—

Compression of charge from A to B.
Explosion from B to C.
Expansion from C to D.
Taking in water and scavenging air and partly exhausting, D to E.
Return stroke completing exhaust till valve shuts, E to F.
Cushioning, F to G.
Cushion expansion, G to H.
Intake of new charge, H to J.
Next compression of charge, J to K.

The partial vacuum at the end of cushion expansion may momentarily be as much as 4 lb. per sq. in., and the water suction may at first be equal to 2 or 3 ft. of water, both dying down to atmospheric pressure during the respective strokes.

The construction of the four-cycle pump is exceedingly simple, and it is the key to all the others. Its reliability has been amply proved, and its elasticity in meeting changes of lift without altering the mixture of gas and air or the clearance volume has been demonstrated. The four unequal strokes which result from the free oscillations of the water column give rise to a cycle which is superior to the Otto cycle, and is, in fact, the theoretically perfect heat cycle described in text-books.

The Humphrey pump exhibited in operation at the Brussels International Exhibition obtained two "highest possible" awards, namely, a Grand Prix in the class for gas engines, and a Grand Prix in the class for pumps.

In the Humphrey pump the burnt gases are so well cooled at the end of the long expansion stroke that they will not ignite an incoming combustible charge. Advantage is taken of this fact to devise a true two-cycle pump, by suitably modifying the combustion chamber, so that the incoming charge displaces the burnt products and mixes as little as possible with them. Each stroke is then a working stroke, and no locking gear is required on the valves. A higher compression pressure is obtained than with the simple pump, and therefore higher efficiency with the same lift. If the pump is stopped by switching off the ignition current, it will be left standing with a charge ready for ignition, starting up when the current is switched on. Otherwise it is easily started with a hand air pump. A double-barrel pump is made, with two combustion chambers in which explosion takes place alternately, and a single water column, and many other modifications have been devised by the author, including suction pumps and high-lift pumps. The gas and air can also be compressed automatically in external receivers, increasing the rapidity of the operation. A 1,000-H.P. Humphrey pump under construction in Germany on this principle occupies no more space than a tandem gas engine of 1,000 H.P. By employing a closed air vessel to receive the water column, with suitable inlet and outlet

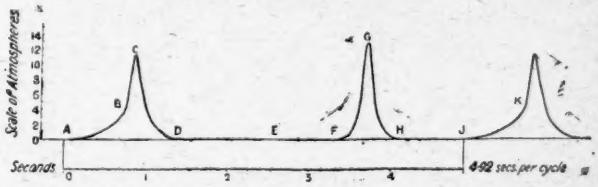


Fig. 2.

air valves, the pump is converted into an air-compressor, of a very efficient type, and having a very wide range of application; for it can be used for compressing a large volume of air at a low pressure, or a small volume at a high pressure, with equal efficiency.

With a compression pressure of 11 atmospheres absolute the theoretical thermal efficiency of the Humphrey cycle is 52·5 per cent., while that of the Otto cycle is only 40 per cent. A compression of this order will be employed in the 1,000-H.P. German pump; the author has only used pressures up to 50 lb. per sq. in., obtaining an actual efficiency of over 23 per cent., corresponding to 0·95 lb. anthracite coal per water H.P.-hour on a lift of 35 ft.

A large scale experiment is to be tried in which a Humphrey pump will be used to drive a water turbine coupled to an electric generator. The advantages of such an arrangement over the ordinary gas engine arise chiefly from the simplicity of the working parts, the absence of all troubles arising from contraction and expansion due to heating and cooling, the freedom from cyclic irregularity, thus enabling alternators to be driven in parallel, and finally, the high efficiency and the low cost of upkeep. Also, the apparatus may be started and stopped immediately, and can, indeed, be entirely controlled from a switchboard. One has to face the loss due to conversion of water-power into mechanical energy, but the efficiency of well-designed turbines can be guaranteed at over 80 per cent. at full load, and in a central station there is no need to run any of the pumps at less than full load, since they can be so easily started and stopped. Moreover, if blast-furnace gas or producer-gas derived from cheap fuel is used, the loss of 20 per cent. of the energy is not important, as compared with the advantages gained by the adoption of the gas-hydro-electric system, and the absence of the need for any lubrication would alone more than compensate for it.

Lastly, it is proposed to apply the Humphrey pump to marine propulsion, and designs have been worked out for this purpose.

Annual Supper.—The annual supper and concert of Messrs. Siemens Bros.' Dalston Works fire brigade and staff was held at the Crown and Castle Hotel, Dalston, on Friday last, December 2nd. The Chairman was Mr. J. Snow Huddleston, manager of cable department, and the proceedings were restricted to members of the firm only. The whole selling force of "tantalum" lamps was present. After supper an attractive musical programme was arranged. The chairman, in proposing a vote of thanks to the committee and secretary, said that he was very glad to be present as a member of the oldest branch of the firm to help the youngest branch of the Siemens firm at Dalston, which showed signs of being very much alive.

A Dundee Cable Contract.—The supply of cables for the electricity department requirements during the next year, for which the committee recommended placing an order with the Union Cable Co. at the last meeting, has been remitted back for further consideration by the Council, there being a general opinion that the work ought not to go to a foreign maker on such a small difference in price, especially as British manufacturers are handicapped by having to work under a special trade union clause.

BUSINESS NOTES.

Book Notices.—"The School of Mines Quarterly." Vol. XXXI, No. 4. July, 1910. New York: Columbia University. Price 50 cents.

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Consular Notes.—Brazil.—A recent report by the Secretary of H.M. Legation at Rio de Janeiro states that concessions were granted during 1909 for the electrification of the Victoria-Minas and the Corcovado mountain railway. The use of electricity in Brazil for traction and other purposes is likely to be greatly developed, aided partly by a distinct movement against the devastation of the forests for the purposes of obtaining fuel. Various schemes were put forward during 1909 for extending the use of electricity in Brazil by generating it from the many waterfalls which occur throughout the country. At present the chief hydraulic stations are in the immediate vicinity of the cities of Rio de Janeiro, Sao Paulo and Santos. Electric traction is used on the steep mountain railway of the Corcovado, and a Bill is before Congress for employing electric traction for the suburban traffic of the Central Railway at Rio de Janeiro, and a decree was signed authorising the electrification of the line from Rio to Petropolis. A decree was signed authorising the Victoria and Minas Railway to use electricity for traction purposes, over 500 kiloms (312½ miles) of line to be generated from certain falls on the Rio Doce, in the State of Espirito Santo. The falls on the San Francisco River, in the Misiones district of the Rio Grande, and of many other rivers, were examined or considered by experts. Much power is already derived from water, and it is likely that this will be replaced by electricity and employed more frequently for mills, railways, &c., especially in those places in the interior where the freight makes coal so expensive on delivery.

Later in this report it is stated that the Brazilian telegraph system is connected with Europe by cables of the Western Telegraph Co., which are extended to Uruguay and the Argentine, and by those of the Compagnie Francaise and the South American Cable Co. The Deutsch Sud Amerikanische Telegraph Gesellschaft also hold a concession to lay a cable with landing rights at Maceio in the State of Alagoas, or at Pernambuco. The Pacific lines are connected with the Brazilian system through the Argentine. The total extent of telegraph lines in Brazil is 30,373 kiloms, of which 782 kiloms were added during 1909. A trunk line following the Atlantic coast runs for 6,400 kiloms from Jaguarao, on the Uruguayan frontier, to Para at the mouth of the Amazon. The chief sections are from Porto Alegre to Curityba, Curytiba to Rio, Rio to Caravellas, Caravellas to Bahia, Bahia to Pernambuco, Pernambuco to Fortaleza, Fortaleza to Sao Luiz, Sao Luiz to Para. To provide against interruptions on the main line large inland circuits have been made from Porto Alegre to Curityba, from Rio to Bahia, from Bahia to Pernambuco, and from Pernambuco to Therezina. There is an inland branch along the Uruguayan and Argentine frontiers, and another from Curityba to Foz de Iguassu, and a further line connects the cities of Sao Paulo and Goyaz, and continues thence to Cuyaba, thus affording a connection with the two inland States of Goyaz and Matto Grosso. During the course of 1909 Capt. Rondon, in charge of a survey party, managed to penetrate the hitherto unexplored country between Cuyaba, in Matto Grosso, and San Antonio on the River Madeira, and traced the route for a telegraph line to connect these two points. Work on this line has already been begun both from Cuyaba and San Antonio, as also on a line from Abuna to Acre. A decree of September 20th, 1909, granted authorisation to the Amazon Telegraph Co. to double their subfluvial cable up the Amazon River between Para and Amatary. This work, which must be completed within 15 months, should obviate the interruptions caused by floating islands and other obstructions. Charges are to be reduced by 20 and 30 per cent. The Cie Generale Radio-Telegraphique of Paris were granted a contract in June, 1909, to erect a long-distance wireless telegraph station in the island of Fernando Noronha, with a range of 1,000 miles. A station at Olinda (Pernambuco) has a range of 300 miles. The wireless telegraph station on the Morro de Babylonia (at Rio de Janeiro) was inaugurated on July 14th, 1909, with the Telefunken system, at a height of 250 metres above the sea level, and with a range up to 250 miles. It corresponds with Cabo Frio (115 kiloms) and with the low power stations on the Ilhas das Cobras, Rigo and Rasa at Ponte Negra and Guaratiba. The Babylonia station received 521 and sent 168 messages (in all 6,500 words) during the first eight months after its installation. The Montserrat station at Santos has a range of 100 miles. A similar station is to be erected at Victoria in Espirito Santo. Though little used in Brazil so far for commercial purposes, wireless telegraphy is likely to be still further developed for communication with ships along its extended coast line and also in the interior, across the dense forests of the Amazon valley, where the dampness and the difficulties of effecting repairs have seriously hindered any extensions inland of ordinary telegraph wires. Wireless telegraph stations are planned at Manaos and San Antonio, and from Goyaz to connect with the North. Most cities in the south of more than 20,000 inhabitants are supplied with the telephone. Sao Paulo and Rio de Janeiro now form the centres of two systems, the former being connected with some 60 towns in the State, including Santos and Braganca. The Rio service is worked under a municipal concession. By decree of August 12th, 1909, the concessionaire of the telephone service of the State of Rio de Janeiro was authorised to lay a submarine cable across the bay to join the Federal capital with Nictheroy, the capital of the State of Rio de Janeiro. Petropolis and other adjacent cities will soon be joined to the Federal capital. In August, 1909, the concession to exploit telephone lines in the State of Bahia was transferred to the Companhia Brasileira de Energia. On March 17th, 1910, authorisation was granted to the Interurban Telephone Co., of Brazil, to carry on business in the Republic, the object of this company being to obtain, work, and sell, telephone and telegraph lines.

Cape Town Electrical Exhibition.—At this Exhibition, which is to be held in the City Hall next March, manufacturers of electrical appliances are invited to exhibit. Particulars will be found among our advertisements to-day.

Liquidations.—Chichester & District Electric Supply Co., Ltd.—At meetings held at Electrical Federation Offices, Kingsway, W.C., on November 4th and 21st, it was resolved to wind up voluntarily. A meeting of creditors is called for December 9th, at 1, Kingsway.

Elliott Water-Tube Boiler Co., Ltd.—A meeting is to be held at 33, Bedford Street, W.C., on January 3rd.

Bankruptcy Proceedings.—C. H. Pearson (Pearson and Co., and the B.O.A. Engineering Co.), electrical, mechanical, and sanitary engineer, Greenheys, Manchester. Receiving order made at Manchester, December 2nd, on debtor's own petition.

Trade Announcements.—Mr. W. A. Tookey, consulting engineer, has removed from 6, Grocers' Hall Court, to new offices at 212, Upper Thames Street. His telegraphic address and telephone number remain unchanged. In conjunction with Mr. J. H. Pearson, member of the Society of Architects, Mr. Tookey is now able to supervise the erection of new buildings, the conversion or alteration of existing structures, and other similar work connected with factory equipment.

The Brush Electrical Engineering Co., Ltd., of London and Loughborough, has established a branch in Canada through the Canada Ford Co., Montreal.

A correspondent says that the Lancashire Industries Co. have taken premises at Prescot (Lancs.) for the manufacture of a new patent motor-starter and other electrical appliances.

Messrs. Berry, Skinner & Co., of Suffolk Works, Oozell's Street, Birmingham, have relinquished the agency for Messrs. Newtons, Ltd., of Taunton, for continuous-current dynamos and motors, and are now representing, in the Midland Counties, Messrs. Mawdsley's, Ltd., of Zone Works, Dursley.

Messrs. Walter Newbold & Co. announce that their business is now being carried on at 10, Arthur Street West, London Bridge, E.C., owing to expiration of lease of their old premises. They have issued a special December list of lathes, drilling, planing and other machines such as they have supplied to tramway, electricity supply, and other public works.

The Rochdale Electric Co., Ltd., have opened new offices and a showroom at 13, Drake Street, Rochdale.

Catalogues and Lists.—The Sun Electrical Co., Ltd., 118-120, Charing Cross Road, London, W.C.—Two new leaflets describing and pricing their self-adjusting nipple for metal-filament lamps and their sign flashers of the magnetic-mercury contact type.

The Switchgear Co., Ltd., Wilfred Street, Salford.—A number of current leaflets, in binding cover, relating to their various switchboard and switchgear specialities, various circuit-breakers, fuses, switches, time lag, Star-Delta starting switches, &c. All of the lists contain illustrated descriptions and prices.

The Holmquist Electric Co., Ltd., 52, Regent Street, London, W.—A number of leaflets dealing with and pricing the following:—Electric light bath cabinets, electric heat pads, irons, kettles, toasters, bed-warmers and other lines simplifying and sweetening the work of the modern household, so that domestics cease from troubling and the mistress is at rest.

The British Thomson-Houston Co., Ltd., Rugby.—New price list (No. 260) of 24 pages, in which they fully describe and profusely illustrate the B.T.-H. rheostatic controllers and resistances, a number of pages being also devoted to tabulated sizes, prices, weights and dimensions, &c. The firm claim to have so designed and constructed this apparatus as to protect both inexperienced operators and the machinery.

Messrs. McGowan, Wild & Co., 206, Hurst Street, Birmingham.—Leaflets illustrating, describing, and pricing their oxy-acetylene welding plant.

The Eclipse Electric Co., 77, St. John's Road, Bootle.—Leaflet showing their Harvey hand and electrically-driven vacuum cleaners, and stating prices.

Messrs. Drake & Gorham, Ltd., 66, Victoria Street, London, S.W.—A folding leaflet has been issued giving prices, &c., of several arc lamps for the Christmas lighting, namely, the Butt flame, Sunshine flame, and enclosed arcs.

From the P. & O. Steam Navigation Co. we have received their usual large hanging sheet setting out the P. & O. outward and homeward mails during 1911. The highly-coloured picture which occupies half of the sheet, depicts the *Morea* (10,890 registered tonnage), the largest P. & O. boat in service, though larger are building.

MESSRS. BAXENDALE & Co., Miller Street, Manchester.—As usual, this firm has issued a catalogue of seasonable gifts. While the list is only directly electrical in that it contains particulars of electric flash lamps, it, of course, contains many things that are of interest to electrical engineers, their wives, and children.

MESSRS. JOHN SPENCER, LTD., Wednesbury.—Illustrated sheet showing and giving some brief particulars of their tubular towers for electric transmission lines, and electric lighting, tramway and telegraph poles.

MR. W. R. SQUIRE, 105, Other Road, Redditch.—Hanging calendar for 1910 with monthly tear-off slips.

THE ELECTRIC CONSTRUCTION CO., LTD., Dashwood House, London, E.C.—New leaflet No. B/264, describing their E.C.C. loom motor, outlining its various advantages in textile factories, and giving characteristic curves of efficiency and speed.

LIGHTING and POWER NOTES.

Argentina.—A syndicate has been formed to take over the electric light station of Mr. B. S. Garcia in Salta. The capital is $3,000,000 paper.

Barnard Castle.—The U.D.C. has decided to offer no objection to the revocation of the E.L. order obtained in July, 1900, by the Northern Counties Electric Supply Co., Ltd., no steps having been taken to carry out the order.

Burnley.—At the last meeting the Electricity Committee was supplied with a list of persons in the outlying residential district of Reedley Hallows who were willing to take a supply of electricity if extended into the district by the Corporation. The town clerk was, as a result, given instructions to obtain all the necessary consents from outside authorities.

Brierfield.—The Nelson Corporation is asking for an order to supply electricity in bulk to the Brierfield District Council, and as the Burnley Corporation runs tramways through the district, the latter authority is taking steps to restrict it to other than traction purposes.

Carnarvon.—A L.G.B. inquiry was held on December 1st into the application of the T.C. for a loan of £1,191 for mains extensions and services. There was no opposition.

Chile.—A concession has been granted to Messrs. Rafael Ovalle and Gilbert Hodgkinson for providing the town of Rancagua with electric light and power. The concession is for a term of 10 years; 12 months are allowed for the completion of the work.

China.—The China Light and Power Co. is making considerable improvements in its electric plant at Kowloon. The old steam sets are to be replaced with a set of three Westinghouse vertical gas engines, each of 150 KW., with a modern switchboard. This will mean that practically all the old plant will have to be scrapped with the exception of one gas engine of 70 KW. These engines will have the effect of causing a very marked reduction in the bill for fuel, which is by far the largest item of expenditure the company has to face. During the past year the company has managed to secure an increase in the number of lamps connected, but the supply of current does not show a corresponding advance, owing to the fact that consumers have to a large extent taken to the use of the metallic-filament lamp. A contract for the supply of light and power to the British section of the Kowloon-Canton Railway has been entered into, which will increase the output considerably. The continued growth of population and residences on the Kowloon peninsula, too, is looked upon with feelings of hope by those who are interested in the success of the company.—*Indian and Eastern Engineer.*

Continental Notes.—FRANCE.—Extensive works are to be carried out next year by the electric company established at Vercors, in Dauphing. It is intended to double the capacity (4,000 H.P.) of the works now situated on the River Bourne. A new hydraulic station is to be built on the same river near Chabert for the supply of light and power to the immediate neighbourhood.—*Revue Pratique de l'Electricité.*

Under the auspices of the Compagnie Générale d'Electricité of Paris, a company has just been formed with a capital of £400,000 and the title La Compagnie Lorraine d'Electricité, to develop the central station of the first-named company in Nancy, and to extend its operations throughout the whole of Lorraine.

A company, styled Société d'Applications Générales Electrochimiques et Mécaniques, has been formed at Paris for the erection of a hydro-electric works for the manufacture of hydrogen and oxygen gas by the electrolysis of water. Its capital is 100,000 fr. The promoters are MM. Henri Dhers and Alexis Lozier.—*Revue Pratique de l'Electricité.*

SPAIN.—*Industria e Invenciones* is informed that an important banking house is interested in the establishment in the North of Spain of a large factory for the manufacture of nitrates similar to those of Chile, the constantly increasing price of which renders its advantageous application to agriculture daily more difficult. Several waterfalls have already been acquired with a view to the erection of stations for the generation of electricity.

Although Barcelona already possesses electric illumination to a certain extent, a supplementary scheme is mooted to supply it with additional motive power equivalent to 23,000 H.P. It is proposed to utilise the River Noguera Pallaresa, and supply energy not only to the companies owning existing networks, but to the public direct by means of a new network. This will naturally create competition and lead to a modification of the somewhat high prices now charged. The Baron De Empain is stated to be at the head of the new venture.

AUSTRIA-HUNGARY.—Activity in electric railway and tramway construction is shown throughout Austria-Hungary. At Pola official sanction has been given to the Istria Elektricitätsgesellschaft to make the preliminary surveys for normal gauge tramways in that town, and like powers for similar undertakings at Drohabycz, in Galicia, and to other promoters at Wieliczka, also in Galicia; while the long-talked-of electric normal gauge railway line from Vienna to Pressburg is now said to be shaping towards realisation. At Kaposvar the Hungarian State Railway Administration intend to erect railway workshops at a cost of 255,000 marks.

Dutch East Indies.—According to a communication from the Belgian Consul at Batavia, the Dutch Government intends setting up an electric station at Soyrabae for the supply of power to work the machinery in the docks, wharves, and arsenal there, and also for lighting purposes in the town. Greater speed in the working of cranes, &c., ashore and afloat, than that provided by steam, is expected, and new machinery is likely to be installed.—*Revue Pratique de l'Electricité.*

Eastbourne.—Application is to be made to the L.G.B. for sanction to borrow £8,000 for extensions during the ensuing three years. The engineer is making inquiries with regard to the hiring of cooking apparatus and also as to the fitting of additional stokers to boilers.

East Cowes (Isle of Wight).—The Isle of Wight Electric Light and Power Co. has offered the District Council to lay down plant at the waterworks for experimental purposes at a cost of £15, the Council to provide the necessary labour, &c., and to pay 1½d. per unit for electricity used; the matter has been referred to the Water Committee.

Eccles.—The T.C. has applied to the L.G.B. for a loan of £1,000 for motors for hire.

Farnworth.—The D.C. has resolved that an amending agreement be entered into embodying revised terms for the supply of electricity in bulk by the Lancashire Electric Power Co. to the Council.

Golborne (near Wigan).—The Lancashire Electric Power Co. is in communication with the U.D.C. with reference to an extension of its mains to Golborne, which is five or six miles distant, for electric lighting purposes.

Haslingden.—It was decided by the T.C. last week to adopt a scheme and estimates, prepared by Mr. Watson, the Bury electrical engineer, and advising expert to Haslingden, for placing the borough in a position to distribute and supply electricity purchased from Accrington Corporation. The estimated expenditure is £5,000, of which £2,524 is for initial expenditure, and £2,476 for services to 100 consumers, street lighting (50 fittings), and cable extensions. Application is to be made for power to borrow the £5,000.

Horsham.—Mr. J. B. Morgan, electrical engineer, has suggested to the U.D.C. that a refuse destructor should be constructed in close proximity to the power station, so that the two can be worked at a minimum of expenditure.

India.—The *Indian Daily News* of November 10th says:—"The Bombay Hydro-Electric Scheme was registered yesterday as a company, with about 400 lakhs capital. The plant will be erected by the Lahmeyer Electrical Co., or rather the Allegemeine Electricitäts Gesellschaft, and will supply 30,000 H.P. to Bombay. It will take two and a half years to erect sufficient to run, but after that the effect on the Bengal coal trade will, we fear, become perceptible. Mr. H. Speyer, of Calcutta, who will superintend the erection, is a director of the company."

The lighting of the yards and transit sheds at the Khulna and Goalundo riverside stations on the Eastern Bengal State Railway has been improved by the provision of 30 arc lamps, for which two generating sets are provided.—*Indian Engineering.*

Leicester.—The Corporation Tramways Committee has asked for the sanction of the Council to the borrowing of £12,000 for cables and works in connection with the supply of electrical energy for power purposes.

Llandaff.—The Whitchurch P.C. having asked that two or three roads should be lighted electrically, the District Council has agreed.

London.—ISLINGTON.—In connection with the electricity *v.* gas controversy, Alderman Vorley, at a recent B.C. meeting, stated that while 24 miles of electrically-lighted streets cost £15,225 per annum, as against 100 miles of gas lighting at £13,112, the electrical candle-power provided was 1,167,936, or 48,000 C.P.

per mile, as against only 190,044 C.P., or 1,900 C.P. per mile in the case of gas, thus, on the basis of illumination, electricity was five times cheaper than gas. The worthy Alderman said there was no intention of going back to gas, and he hoped the *Gas World* would take note of that. As a matter of fact, the B.C. has decided to replace 40 additional gas lamps by 16 high C.P. arcs, with a saving of £34 10s. per annum in cost.

FULHAM.—The E.L. Committee reports 120 applications for free wiring on consumers' premises, of which 80 have been connected to the mains.

LEWISHAM.—The South Metropolitan E.L. and Power Co. has been conditionally granted permission to erect high candle-power lamps in Burntash Road, between Taunton Road and Lee Road.

WOOLWICH.—The Finance Committee reported having considered a memorandum with reference to the present position of the wiring capital account, which showed that on September 30th last the balances in hand on hire-purchase and hire-rentals accounts were approximately only £191 13s. 5d. and £146 10s. 3d., whereas the expenditure during the past half-year on both services had greatly exceeded these balances. Upon the recommendation of the Finance Committee, the Council resolved to apply to the L.G.B. for sanction to borrow £3,000, allocating £2,000 for hire-purchase and £1,000 for hire-rental, the payment to be spread over a period of 10 years for both purposes.

SOUTHWARK.—The L.C.C. has agreed to the borrowing by the B.C. of £6,909 for the purchase of turbo-generating plant and switchgear, the loan to be repayable in 20 years.

Loughborough.—The T.C. on Monday last, decided to extend the generating plant so as to increase the output by 200 KW., at a cost of from £2,000 to £2,500.

Northwich.—The U.D.C. has consented to the Electric Supply Co., Ltd., fixing six lamps in the town for the purpose of demonstrating the utility of electricity for street lighting.

Maghera.—The lighting of this town by electricity was recently accomplished. The installation consists of a 46-B.H.P. Fielding & Platt suction gas engine driving a 23-KW. 220-volt dynamo. The lighting of the streets is by 50-C.P. metal-filament lamps. A battery of 122 Chloride cells is installed to facilitate lighting on Sundays and other periods of light loads.

Oldham.—The Chamber of Trade, at the request of the Electrical Sections, has decided to watch the progress of the Bill being promoted by the I.M.E.A., seeking powers to enable local authorities to deal in fittings, lamps, &c., and to undertake wiring work, and to communicate with the National Chamber of Trade on the matter. The Chamber successfully opposed the application of the T.C. for similar powers.

Stoke-on-Trent.—The T.C. has applied to the L.G.B. for a loan of £1,200 for mains extensions.

South Africa.—CAPE TOWN.—In connection with the visit of the Duke of Connaught to Cape Town for the purpose of opening the first Union Parliament, the electrical illuminations formed a great feature. The principal streets were ablaze with light for about 10 nights, and, generally speaking, the illuminations were on a scale never before attempted in any part of South Africa. There were in all over 100,000 lamps, mostly of 8 or 5 C.P. in use for illumination purposes, and as, on several occasions, the full ordinary night load was required, in addition for shop lighting, the resources of the Corporation electric light station were taxed to the uttermost. The tramway company generously supplied energy for some of the street lights. The four principal streets, Adderley Street, St. George's Street, Darling Street, and Plein Street, were festooned from end to end with thousands of lights, and in addition each of the four arches, representing the four provinces of the Union, had about 1,200 lights. The railway station had numerous elaborate designs and transparencies requiring about 15,000 lights, and the G.P.O. depending on fewer designs, but a more thoroughly carried out outline, had about the same number of lights. The Government Avenue wes festooned with 3,000 coloured lights, and the Houses of Parliament, Supreme Court, and Harbour Board Buildings, had each very tasteful outlines. Most of the principal business premises had either outlines or designs, the word "Welcome," the Royal initials and crowns being especially in evidence. A notable part of the illuminations was a sign flasher advertising a local brand of Colonial wines—although common enough elsewhere, a sign flasher had never hitherto been seen in Cape Town, and this caused considerable astonishment to the up-country visitors.

The Bulawayo Waterworks Co. has arranged a contract with Messrs. Stenmark & Vaaler, electrical engineers, for the renovation of the street lighting system of the town. Nearly 200 new street lamps and three new transformers will be provided. A new type of lightning arrester will be fitted at 52 different points of the system.

The agreement between the promoters of the Tweefontein electrical power scheme and the Government is expected to be signed at an early date, when the execution of the undertaking will be entered upon without delay.—*Commercial Intelligence.*

Stone (Staffs.)—The U.D.C. has appointed a Sub-Committee to consider an electric light scheme prepared by Mr. P. J. S. Tiddeman, of Stoke-on-Trent.

Torquay.—Mains are to be extended at a cost of £180 to supply Wilkins & Sons, the contractors for the erection of the new municipal buildings. During the past month the equivalent of 353 8-C.P. lamps have been connected, while 45 public gas lamps have been replaced with 100-C.P. electric lamps, and five of the arc lamps on the Torbay Road have been replaced with 1,000-C.P. lamps.

Trowbridge.—The U.D.C. has referred to a Committee a proposal to establish electricity works in the town on the same lines as the installation at Chippenham, made by Mr. Edwards, of the firm of Edwards & Armstrong, of Bristol. The scheme has been favourably received, and the Council will offer no objection.

Wednesbury.—In order to meet the increased demand for electricity, the T.C. has installed a new gas engine at the electricity works.

Wellington (Salop).—At a meeting of the U.D.C. on December 1st, a letter was received stating that Messrs. J. and W. Purves, of Exeter, intended to postpone their application for a prov. order for E.L. until next year.

West Africa.—It is proposed to establish an electric power plant at Dakar, French Senegal.—*African Engineering.*

Wimbledon.—The local Traders' Association has asked for a supply of electricity on special terms for a Christmas street decoration scheme. The Council offers to provide services and to connect up the lamps used in connection with decorations for £18, and supply energy at 1s. per 100 8-C.P. lamps per hour. Electric theatres are to be supplied with energy upon the following terms:—(1) Ordinary lighting rates between 4 p.m. and 9.30 p.m., and 1d. per unit between 9.30 p.m. and 4 p.m. on the following day; (2) a minimum consumption of 10,000 units per annum to be guaranteed; (3) meters to be read weekly, and accounts to be paid within three days after rendering, and £10 to be deposited.

Winchester.—The Electric Light Committee of the T.C. has settled the terms with regard to the purchase of the electric light undertaking. Although particulars of the agreement have not yet been publicly disclosed, it is believed to be very satisfactory. The Corporation has decided to fix the common seal of the Council to the petition for leave to introduce the Winchester Corporation (Electric Supply) Bill into the next session of Parliament

TRAMWAY and RAILWAY NOTES.

Argentine.—The Rosario City Council has been in negotiation for some time with the Rosario Electric Tramway Co. with a view to the extension of the latter's system. The company, whose concession is for 55 years, now asks for a further extension of 25 years, in compensation for the cost of constructing another 40 km. of line. The Council also desires a uniform tariff of 10 cents.

The Rosario Electricity Co., which now belongs to Belgian capitalists, has purchased the power house of the Rosario Electric Tramway Co.—*Review of the River Plate.*

Canada.—It is announced that when the Grand Trunk elevation work, now in progress in Montreal, is completed, the use of steam locomotives on the company's city lines will be discontinued, and electrically-driven locomotives will be introduced. Additional capital for terminal and electrification purposes will be provided for by legislation in the present session of the Canadian Parliament. Plant which the Canadian Light and Power Co. is erecting at St. Timothy, Montreal, is owned by interests associated with the Grand Trunk. This plant, which will produce 100,000 H.P., is expected to be ready for operation by the time the Grand Trunk has completed its track elevation and other terminal arrangements in Montreal.

Blackpool.—The last remaining relic of the old conduit system of tramways is soon to disappear, the Tramways Committee having decided to relay the track in Station Road, South Shore. They will at the same time connect up with the Promenade section, and establish a new circular route, which will convey passengers along the Promenade from the North Pier to the Victoria Pier, and then round Marton, *viâ* Station Road and Waterloo Road. The circular tour will then cover nearly five miles.

Continental Notes.—GERMANY.—A new underground electric railway has just been opened to serve the Berlin suburban district of Schoneberg, and is expected in the course of time to be extended into the inner part of Berlin. The railway is claimed to be the first in the world which has been constructed for and worked by the local authority, which in this instance is the Schoneberg Town Council. Almost simultaneously with the opening of this line to traffic, the Berlin City Council decided to proceed with the long-discussed railway between the north and the south, at an estimated expenditure of £2,690,000. The length of the railway will be four miles, and the number of stations will be 11.

A company has just been formed at Heilbronn with the object of establishing and working a railless system of electrical public service vehicles between that town and Bockingen, Wurtemburg.

Spain.—The *Gaceta* states that the Compania del Tranvia Urbano del Bilbao has applied for a concession for the construction and working of an electric tramway in Bilbao, from the Plazuela de Santiago to the Plazuela de San Nicolas; also that the Sociedad Anonima Tranvais de Valladolid has made application for a concession for the construction and working of an electric tramway in Valladolid.

France.—An extensive scheme of electric tramways serving the four French Departments of Loire-et-Cher, Indre-et-Loire, Loire and Eure-et-Loir, is on the eve of realisation by the definitive ratification of the concession accorded M. Charles Lefebre. The Minister of Public Works is now engaged in preparing the decree of "public utility," which only awaits the signature of the President of the Republic, which will be sought in the course of a few days, to become an operative instrument. All the other preliminary conditions have been completed.—*Revue Pratique de l'Electricité.*

Italy.—The new railway programme, due (says the *Giornale dei Lavori Pubblici e della Strade Ferrate*) to the Hon. Emmanuelle Lanerotti and the Engineer Baudracco Mario, has for object the development of the Trentino portion of the Italian Alps, and will affect 400 km. of railway track, and involve an expenditure of 71,000,000 lire. The programme is divided into four sections. The central one comprises the trans-Alpine line, which will traverse the Bernina, the Aprica and the Tonale mountains, the Val di Sole, the Val di Non, the valley of the Adige and the Valleys of the Avisio and of the Corderde and has a particular international importance; the southern, which starts from Riva and the Lake Garda, its principal line being the Ferrovia Giudicariese; the northern serving the districts of the Upper Adige with an extension through the Buffaloro Pass and into the Gardena valley, and lastly, the group embracing the connecting and supplementary lines forming the secondary artery of the whole railway system. This new network of railways will be worked by hydro-electric power. The available power may be reckoned at 240,000 H.P., of which 20,000 only are as yet utilised. It is intended to contruct a central station on the Avisio, near Capriana, another on the Noce, at Mostizzolo, of 2,000 H.P., and one each on the Sarca, Chiese, &c.

Austria.—The Ministry of Railways has given permission to the T.C. of Trieste to make the preliminary surveys and estimates for the introduction of electric tramways within the municipal boundaries. Similar permissions have been accorded to Herr Julius Reither, Burgermaster of Misslitz (Mähren), and also to the T.C. of Karlsbad. At Salzburg the extension of the existing tramway network has been voted by the Municipal Council, at an estimated cost of 1,300,000 kronen.—*Der Elektrotechniker.*

An extensive scheme for the utilisation of Lakes Fuschl and Mond has been initiated on behalf of the Austrian State Railways. The leading idea is to connect the two lakes and to take advantage of the difference of level, some 180 metres, for the generation of electricity. It is intended to tap the first-named lake by means of a tunnel carried through the Schoberberg to the station to be built near St. Lorenz, the outflow being returned *viâ* the Grieslerache River into Lake Mond. An alternative scheme proposes to lead the water from Lake Fuschl by means of a short tunnel to a power house to be built near Thalgau.

Dudley.—As the result of arbitration, the price of energy supplied to the Tramway Co. by the T.C has been fixed at 1·33d. per unit for supplies ranging from 700,000 to 750,000 units per annum, and at 1·01d. in place of 1·27d. for quantities between 800,000 and 1,100,000 units.

Hove.—The T.C. will oppose the Bill of the Brighton, Hove and Preston United Omnibus Co., Ltd., for powers to construct overhead apparatus for trolley 'buses in the district.

Japan.—An application has been made to the Japanese Government for a charter for a projected electric railway between Tokio and Osaka.

Kirkcaldy.—The Tramways Committee has been considering the question of the excessive overcrowding of the cars when any big football match is taking place, and the consequent limited service, as the track at this part is a single line with turn-outs. Amongst the proposals made to remedy matters was one that trailers be provided, but this was abandoned on account of the capital expenditure and working expense involved. It was ultimately agreed to recommend the T.C. that the halfpenny fare be abolished on Saturdays after two o'clock.

Liverpool.—The Tramways Committee has decided to recommend the City Council to purchase the undertaking and property of the Woolton Motor Omnibus Co. These 'buses were instituted about three years ago, taking the place of the old horse 'bus which had for many years run between Woolton and Liverpool. In Woolton the action of the Liverpool Corporation is regarded as a step towards the incorporation of the village with the city.

London.—Owing to a landslide which occurred in Archway Road, near Highgate Archway, some poplar trees fell over the overhead wires of the Metropolitan Tramways, bringing them down and stopping traffic.

Manchester.—The *London Gazette* of December 6th contains official notices relating to the intention of the U.D.C.'s of Denton and Droylsden to transfer their tramway leases to the Manchester Corporation.

Paraguay.—According to the *Review of the River Plate*, a regular "battle royal" is raging in Asuncion, Paraguay, in connection with the granting of a concession for electric tramways and an electric power house in that city. Mr. Carosio, of Buenos Ayres, is one of the applicants for this concession, and he has a majority in his favour in the Chamber of Deputies. Mr. Manuel Rodriguez, chairman of the Central Paraguay Railway Co., is the other applicant. He has now asked the Senate to regulate the electrification of tramways, as his company has purchased the Villa Mora line, and desires to electrify it. As guarantee of good faith he has put up $50,000 gold. On the top of all this, which has divided the citizens of Asuncion into two parties, comes along Mr. Charles Bright (well known in Buenos Ayres in connection with concessions for electric tramways, tubes, &c.) as representing Mr. Muller, who holds a concession for electric tramways and a power house. Mr. Bright threatens Paraguay with a lawsuit if Congress grants another concession for a power house. He maintains that the concession for the tramways has expired, but not that for the power house.

Rotherham.—At a special meeting on the 1st inst., the T.C. approved, by 23 votes to 4, an application to Parliament for a Bill which includes a system of trolley 'buses between Rotherham and Maltby, Tickhill, Dinnington and Aston, all districts which have lately developed considerably through the opening out of collieries.

South Lancashire.—A local correspondent informs us that some hundreds of persons have signed a petition to the B. of T. asking for the restarting of the service on the South Lancashire Tramways Co.'s line from Worsley to Winton, which had been discontinued, owing to the intervention of the Eccles Corporation.

West Africa.—Although local conditions are favourable to the proposed electrification of the Matadi-Leopoldville Railway, Congo, the seheme is to be deferred, as the present traffic does not warrant the necessary expenditure.—*African Engineering.*

TELEGRAPH and TELEPHONE NOTES.

N.T. Co. and its Construction Staff.—A memorandum was issued on November 23rd by the National Telephone Co., in which, after referring to the difficulties experienced in the way of securing employment for its construction staff until the termination of the licence, and the failure of the negotiations with the Post Office to enable capital expenditure to proceed in such a way as to provide for a full employment of the staff, it is stated that the policy which the company had proposed to adopt would have necessitated the cessation of canvassing for new business during some portion of the year 1911, thus entailing some further dismissals of staff. In view, however, of the undoubted hardship such a course would involve, the board has now agreed to modify that policy so as to continue canvassing and consequent development of existing plant for a later period than was previously contemplated. The result of this decision enables the company to state that unless unforeseen circumstances arise it will be able to retain its existing staff (including construction staff) until the end of the licence. This statement, says the *National Telephone Journal*, will lift a heavy burden of doubt and apprehension from the minds of many of the employés of the company.

The Pacific Cable.—The accounts for the year ending March 31st, 1910, published last week, show net traffic receipts £111,465, making, with sundry small items, a total of £111,724; expenditure amounted to £93,767, including £30,000 to renewal account, leaving a surplus of £17,957 available for reduction of the amount (£77,544) payable for interest and sinking fund upon the capital. The associated Governments will, therefore, have to pay £59,588, as compared with £60,888 last year.

The increase in traffic receipts was only £403, but to this a sum of £2,211 (accidentally credited after March 31st) should be added, making a total of £2,614 increase. The miscellaneous receipts were less by £1,773, and the total receipts less by £1,370 than in 1908-9. Expenditure also decreased, by £2,668. The renewal fund stood at £219,488, and with interest on investments, as well as the annual appropriation of £30,000 from revenue, is growing at the rate of £37,000 a year. For the current year the traffic receipts were estimated at £128,000, and the working expenses at £84,702, but amended estimates put the receipts at £135,000. The cable worked for 11 months without interruption or repair, but early in March the first break recorded took place near Doubtless Bay station, interrupting communication on the New Zealand-Norfolk Island section for five days. The break was caused by chafing on rock, and was repaired by the board's repairing vessel. As already reported, the board has secured for five years the exclusive use of a line of the Canadian Pacific Railway between Montreal and Bamfield, which will prevent delay and increase the accuracy of transmission. The reduction of rates for Press telegrams from 1s. to 9d. a word on August 1st last year has resulted in a revenue from this source of £250 a month. During the year 115,663 international messages, representing 1,356,136 words, were dealt with, besides a very considerable intercolonial traffic on the southern sections.

Russia.—Telephonic communication has recently been established between Moscow and Nijni Novgorod and the important cotton spinning centres of Vladimir, Shuy and Ivanovo-Vosnesensk.

Switzerland.—The Government has authorised the acquisition of the material necessary for the erection of long-distance telephones on the Egner and Holmström system. This system is said to allow of conversation over distances of between 3,000 and 4,000 kilometres.—*Electron.*

Turkey.—The Imperial Post and Telegraph Department is contemplating the erection of a wireless telegraph station at Alaschati or Karaburun, near Smyrna. Firms interested must apply for particulars to the Department.—*Der Elektrotechniker.*

Wireless Telegraphy.—The British hired transports *Soudan*, *Rohilla*, *Dongola*, *Rewa* and *Plassy* have been fitted with Marconi's wireless telegraph apparatus.

Wireless Telephony.—Experiments carried out by French battleships have resulted in successful conversation at a distance of 72 miles.

CONTRACTS OPEN and CLOSED.

OPEN.

Australia.—December 13th.—Bare hard-drawn copper cable, for the Melbourne City Council. See "Official Notices" November 25th.

December 21st.—Concentric lead-covered, single-conductor lead-covered, and three-core lead-covered cables, for the Melbourne City Council. See "Official Notices" to-day.

December 29th.—(*a*) Telephone cable, (*b*) battery and line material and instruments, for the P.M.G.'s Department in South Australia. See two "Official Notices" November 4th.

January 4th, 1911. Three multiple switchboards, for the P.M.G.'s Department in New South Wales. See "Official Notices" November 4th.

January 4th, 1911.—Iron poles, ironwork, and switchboards, for the P.M.G.'s Department in Queensland. See "Official Notices" November 18th.

January 10th, 1911.—Telephone cable, for the P.M.G.'s Department in Victoria. See "Official Notices" November 18th.

January 10th, 1911.—Contacts and condensers, for the P.M.G.'s Department in Victoria. See "Official Notices" November 18th.

January 24th, 1911.—Wire, twisted pair, for the P.M.G.'s Department in Victoria. See "Official Notices" December 2nd.

January 25th, 1911.—Portable petrol-driven winch, for the P.M.G.'s Department in New South Wales. See "Official Notices" December 2nd.

January 25th, 1911.—Insulators, wire, &c., for the P.M.G.'s Department in South Australia. See "Official Notices" Dec. 2nd.

February 1st, 1911.—Testing equipment, for the P.M.G.'s Department in New South Wales. See "Official Notices" to-day.

MELBOURNE.—February 22nd, 1911. 2,000 steel tramway plates. Specification, conditions, &c., at the City Surveyor's office, Town Hall.

PERTH.—April 18th, 1911. According to the *Australian Mining Standard*, tenders are invited for one common-battery switchboard for the Perth Central Exchange, consisting of two junction, seven subscribers', four end, two cable turning and two cable storing sections, together with all necessary frame racks, power plant, and associated apparatus, as per Specification No. 353 and Schedule No. 85. Specifications, &c., at the office of the High Commissioner, London.

According to the *Australian Mining Standard*, the Sydney City Council will shortly invite tenders for the supply of lubricating oils for 12 months ending January, 1912, and coal for one, two or three years. The Council has decided to provide and equip repair-shops for carrying out repairs in connection with the electric lighting department, and tenders are to be invited for workshop machine tools for this purpose, to a specification of the City Electrical Engineer.

SYDNEY.—January 23rd. Two 750-KW. units for Newtown sub-station for the Government Railways. Particulars at Electrical Engineer's Office, 61, Hunter Street, Sydney, N.S.W.

WESTERN AUSTRALIA.—February 28th. Electrical pumping machinery for the Minister of Public Works. Conditions, &c. (one guinea) from the Contractors' Room, Public Works Office, Perth.

Barking.—December 20th. 400-KW. Diesel engine and dynamo, 250-KW. motor-generator, traction battery and reversible booster, main switchboard and connections, and overhead travelling crane, for the U.D.C. Specification from Mr. Henley L. Howard, engineer (deposit two guineas).

Birmingham.—December 12th. Sixty electric tramway cars and 400 tramway poles, for the T.C.; Tramway Offices, 147, Corporation Street (returnable deposit £2 in case of cars).

Bispham-with-Norbeck.—The U.D.C. has invited tenders for the supply of material and erection of the electrical generating station in Red Bank Road, Bispham.

Bohemia.—The municipal authorities of the little town of Kralup are at present inviting tenders for the establishment of a central electric lighting station.

Canada.—December 22nd. Calgary (Alberta) City Commissioners want tenders for a 1,500-H.P. synchronous motor-generator, motor-generator exciter set, switchboard, &c. Specification to be seen at the C.I. Branch of the Board of Trade in London.

East Ham.—December 30th. One 1,000-KW. triple-expansion medium-speed steam engine and generator, and one evaporative condenser, with air and circulating pumps, piping, &c., for the Corporation. See "Official Notices" to-day.

Edmonton.—December 14th. Metal and carbon-filament lamps, for the Guardians. See "Official Notices" to-day.

India.—In the issue of *Indian Engineering* for November 12th an official advertisement appeared relating to the Simla hydro-electric scheme, inviting tenders for the supply and erection of steel penstocks, Pelton wheels, alternators, exciters, transformers and switchgear. Typed copies of all the specifications, complete with drawings and full particulars, were deposited in the office of the Superintending Engineer, Central Circle, Bengal, and Public Works Department, Calcutta; and copies of each specification and drawings were to be obtained from the Executive Engineer, Simla Hydro-Electric Scheme, Basantpore *via* Mashobra, Simla, upon receipt of 35 rupees per copy.

Leytonstone.—December 30th. Electric lighting installation at the new County High School, Forest Road, for the Essex Education Committee. See "Official Notices" to-day.

Llandudno.—December 24th. (*a*) Motor-driven induced-draught plant, (*b*) mechanical stokers for one Lancashire and one Babcock boiler, for the U.D.C. See "Official Notices" to-day.

Limerick.—December 12th. Wiring and fittings for lighting, bells and telephones, at the new Borough Technical Schools, Military Road. See "Official Notices" December 2nd.

London. — ISLINGTON.—January 12th, 1911. High-tension switchboard for the Borough Council Electricity Works. See "Official Notices" November 25th.

L.C.C.—Only two tenders were received from selected firms for the overhead electrical equipment of the Old Kent Road Stores Depôt, and neither is to be accepted. Fresh tenders are to be invited.

January 10th, 1911.—High and low-tension switchgear. See "Official Notices" to-day.

New Zealand.— INVERCARGILL. — January 9th, 1911. Power-house plant, cars, rails, overhead material, wires and cables, poles, &c., for an electric trolley system, also street-lighting plant for the Corporation. See "Official Notices" October 14th.

TAIHAPE.—January 11th. Hydro-electric lighting and pumping plant for the B.C. Specification can be seen at C.I. Department of the Board of Trade in London.

Rotherham. — December 13th. High-tension feeder and rotary converters, transformer and switchgear, for the Corporation. See "Official Notices" November 25th.

Roumania.—December 31st. Electric lighting of the City of Botoschan for the municipal authorities. Deposit, £2,610. Herr Bürgermeister, Botoschan. Competency certificates to be lodged by December 21st.

Shanghai.—January 4th, 1911. Two turbo-alternators, 2,000 to 2,500 KW., with condensing plant, and four water-tube boilers, with integral superheaters, mechanical stokers, economisers, &c., for the Municipal Council. See "Official Notices" to-day.

Spain.—December 17th. Supply of converter and underground cable with accessories for driving electric cranes on the pier of Santa-Lucia. Deposit, 500 pesetas, Commission of Works of the port of Corunna.

Tenders have just been invited by the municipal authorities of Angles (province of Gerona) for the concession for the electric lighting of the town during a period of 20 years.

Trimdon Grange (co. Durham). — December 10th. Electrical fittings for a year, for Walter Scott, Ltd., Trimdon Grange Colliery, co. Durham; the Storekeeper.

CLOSED.

Admiralty.—The Admiralty have placed an order for extensive coal tipping and loading plant with Messrs. Ed. Bennis and Co., Ltd.

Australia.—According to the *Australian Mining Standard* the following contracts have recently been placed :—

Kalgoorlie Municipal Council (W.A.) :

Noyes Bros.—80-H.P. electric motor for Mullingar stone-crushing plant, £69.

Sydney City Council :

Crompton & Co., Ltd.—Electric capstans for Pyrmont power house, £596.
British Insulated and Helsby Cables, Ltd.—12 feeder pillar boxes, £50 each.
W. G. Watson & Co., Ltd.—20-mm. and 2-in. cored carbons, and 13-mm. 2-in. solid ditto, C quality "Conradty," £5 9s. per 1,000 pairs.

Postmaster-General's Department, Western Australia :

India-Rubber, Gutta-Percha and Telegraph Works, Ltd., Perth.—5,000 spindles, galvanised iron, at 3¾d. each—£70 6s. 3d.; 1,000 spindles, galvanised steel, 5¼d. each—£22 18s. 4d.
G. P. Harris, Scarfe & Co., Ltd., Perth.—Six steel towers, 40 ft., £10 10s. each; 10 steel towers, 50 ft., £16 each; total, £223.

Blackburn.—The Education Committee has accepted the tender of the Howe Electrical Co., Blackburn, for installing electric light at Bangor Street Council School.

Bolton.—The Electricity Committee has accepted the tender of the British Insulated and Helsby Cables, Ltd., for 12 months' supply of cables.

Brixham.—Messrs. George Schultz & Co., of London, have secured the contract for the installation of machinery, &c., for the lighting of Brixham by electricity, an undertaking to be carried out under the Brixham Gas Co.

Buenos Ayres.—The *Review of the River Plate* states that an order has been placed by the Buenos Ayres Southern Tramway Co. with Messrs. Colson, Brookhouse & Pyne for 10,000 metres of underground armoured feeder cables, which will be manufactured by the British Insulated and Helsby Cables, Ltd., at Prescot. Tenders were received from all the principal Continental cable-makers.

Derby.—The T.C. has accepted the tender of Messrs. Chamberlain & Hookham, Ltd., of Birmingham, for the maintenance of meters on tramcars, at £153.

Eccles.—The T.C. has accepted the quotation of the British Westinghouse Electric & Manufacturing Co., Ltd., for the annual supply of consumers' electricity meters.

London.—The Metropolitan Asylums Board has accepted the following tenders :—

Siemens Bros. & Co.—Apparatus for electrical treatment of paralysis, &c., £23.
Newton & Co.—X-ray apparatus, £72; quartz lamp for treatment of lupus, £24.

Poplar.—The B.C. has received the following tenders for renewals of incandescent lamps for street lighting, the cost of which last year was £320 :—

British Economical Lamp Co. (accepted for three years).—(*a*, make of lamp), Brimsdown; (*b*, annual cost), £165 18s.; (*c*, make-up lamps each), 1s. 9d.
Haydn T. Harrison.—(*a*), Osram; (*b*), £275 15s.; (*c*), 2s. 1d.
Drake & Gorham.—(*a*), Osram; (*b*), £297; (*c*), 2s. 1d.
Gillespie & Beales.—(*a*), Mazda; (*b*), £344 14s. 9d.; (*c*), 2s. 1d.

The engineer reported that in the case of the British Economical Lamp Co., the lamps at the end of the contract remain the property of the company, while the other tenders provided for the lamps to become the property of the Council. The lamps of the British Economical Lamp Co. have been tested in use and in the laboratory, and were found to be satisfactory. The Electricity Committee reported this company's tender to be the most satisfactory.

Walton.—At the meeting of the Metropolitan Water Board on Friday, it was reported that the following tenders had been received for the wiring, &c., of the engine and boiler houses at Walton :—

"Stannos" :—	
H. Keen & Co...	£460
H. J. Whitehead	490
Beaven & Sons, Ltd.	563
Thames Ironworks, &c., Co., Ltd.	1,005
Lead-covered :—	
Board's own Staff	420
H. Keen & Co...	453
H. J. Whitehead	485

It was decided that the work should be carried out by the Board's electricians at a total cost, including labour and materials, not to exceed £420.

Warrington.—The T.C. has accepted the following tenders at schedules of prices :—

British Electrical Engineering Co., Ltd.—Transformers.
British Westinghouse Co.—Direct-current motors.
Electric Construction Co.—Alternating-current motors.

Wigan.—The T.C. received the following tenders for the supply and laying of cables from the Cherry Gardens Inn to the pumping station at Boar's Head :—

Siemens Bros. & Co., Ltd.	£838
W. T. Henley's Telegraph Works Co., Ltd.	843
Western Electric Co., Ltd.	844
Callender's Cable and Construction Co., Ltd.	847
British Insulated and Helsby Cables, Ltd.	894
W. T. Glover & Co., Ltd. (accepted)	921
Johnson & Phillips, Ltd.	931

The following tenders were received for the supply of cables for stock :—

Siemens Bros. & Co., Ltd.	£433
W. T. Henley's Telegraph Works Co., Ltd.	430
Western Electric Co, Ltd.	430
Callender's Cable and Construction Co., Ltd.	432
British Insulated and Helsby Cables, Ltd.	428
W. T. Glover & Co., Ltd. (accepted)	422
Johnson & Phillips, Ltd.	428

The following were received for the conversion of two G.E.C. feeder boosters from 20 to 75 volts, including the turning up of the commutators and testing :—

P. R. Jackson & Co., Ltd. (accepted)	£51
General Electric Co., Ltd.	116
Lancashire Dynamo and Motor Co., Ltd.	75

Wimbledon.—The T.C. has accepted the following tenders :—

British Thomson-Houston Co., Ltd.—116 low-tension switch fuse panels for the transformer sub-stations, £484.
Meyers, Rose & Co., Ltd.—3,000 tons of Ilkestone, Mapperley, or West Hallam slack coal, at 11s. 11d. per ton.

FORTHCOMING EVENTS.

Illuminating Engineering Society.—Friday, December 9th. At 8 p.m. At the Royal Society of Arts. Paper on "Recent Progress in Electric Lighting," by Prof. E. W. Marchant.

North of England Institute of Mining and Mechanical Engineers.—Saturday, December 10th. At 2 p.m. At the Wood Memorial Hall, Newcastle. Papers on "The Holmes-Alderson Automatic Fire-damp Cut-out," by Mr. G. Ralph; and "Electric Winding, with Special Reference to its Development in Upper Silesia," by Mr. H. M. Hudspeth.

Royal Society of Arts.—Monday, December 12th. At 8 p.m. Cantor lecture on "Industrial Pyrometry," by Mr. C. R. Darling. (Lecture IV.)

Institution of Mechanical Engineers (Graduates' Association).—Monday, December 12th. At 8 p.m. Paper on "Requirements of Illumination and the Status of Gas Lighting," by Mr. J. C. Briggs.

Institution of Electrical Engineers (Newcastle Local Section).—Monday, December 12th. At 8 p.m. At the Armstrong College, Newcastle. Discussion to be resumed on "Electric Winders."

Institution of Electrical Engineers (Manchester Students' Section).—Tuesday, December 13th. At 7.30 p.m. At the Municipal School of Technology, Manchester. Paper on "Organisation and the Reduction of Manufacturing Costs," by Mr. A. R. Stelling.

Institution of Electrical Engineers (Yorkshire Local Section).—Tuesday, December 13th. At 7.45 p.m. At the Metropole Hotel, Leeds. Smoking concert.

Faraday Society.—Tuesday, December 13th. At 8 p.m. At the Institution of Electrical Engineers. Papers on the "Separation of Oxygen by Cold," by Mr. James Swinburne, and "New Apparatus for the Rapid Electro-analytical Determination of Metals," by Dr. H. J. S. Sand and Mr. W. M. Smalley.

Institution of Electrical Engineers (London Students).—Wednesday, December 14th. At 7.30 p.m. At the Institution Building, Embankment, W.C. Paper on "Progress in Arc Lamps," by Mr. J. F. Shipley.

Institution of Electrical Engineers (Glasgow Local Section).—Wednesday, December 14th. At 6.30 p.m. for 7 p.m. At the Grosvenor, Glasgow. Ninth annual dinner.

Institution of Electrical Engineers (Birmingham Local Section).—Wednesday, December 14th. At 7.30 p.m. At the University, Birmingham. Paper on "Street Lighting by Modern Electric Lamps," by Mr. H. T. Harrison.

Junior Institution of Engineers.—Wednesday, December 14th. At 7.30 p.m. At the Royal United Service Institution, Whitehall, S.W. Paper on "Some Recent Developments in Condensing Plant," by Mr. G. L. Kothny.
Saturday, December 17th. At 3 p.m. Visit to the new G.P.O. power station, Blackfriars, and sub-stations.

Institution of Electrical Engineers (London).—Thursday, December 15th. At 8 p.m. At Institution Building, Embankment, W.C. Paper on "Submarine Cables for Long-distance Telephone Circuits," by Major W. A. J. O'Meara.

THE ELECTRICAL ENGINEERS
(LONDON DIVISION).

THE following orders are issued :—

Commanding Officer—COL. H. M. LEAF.

Monday, December 12th.—"A" Company. Technical drill, 7 to 10 p.m.
Tuesday, December 13th.—"B" Company. Technical drill, 7 to 10 p.m.
Thursday, December 15th.—"C" Company. Technical drill, 7 to 10 p.m.
Friday, December 16th.—"D" Company. Technical drill, 7 to 10 p.m.

(Signed) P. H. CAMPBELL, Capt. R.E., Adjutant.

Copper.—Messrs. Merton's statistics for November 30th show a decrease in visible supplies (European) of 1,172 tons for the month; French stocks having increased 307 tons, and Chile shipments afloat being 800 tons up, with Australian 100 tons up, the total withdrawal is 2,379 tons. The decrease per month since February last has averaged 2,720 tons, so that it will be seen that this is at a much slower rate. Trade, however, continues brisk, as shown by deliveries of 43,101 tons. The supplies from North America are still low, though appreciating. Spain and Portugal show rather higher, Chile shipments are up to average, and Australian above average. American supplies for the month ending October 31st are 62,170 tons, a reduction of 4,255 tons on the preceding month. The total reduction since the end of July has been 14,009 tons, or 4,667 tons per month.

NOTES.

Dry Splices in Galvanised Iron Wire.—A useful article by C. T. Rashman appeared in the *Electrical World* for November 17th, describing tests made to decide which type of splice behaved best when subjected to tension, and to determine a style of splice that would develop a tensile strength equal to that of the wire of which it is made. Splices of the typical forms of figs. 1, 2 and 3 were made of No. 12 wire, and tested to destruction. None of the three was found to be as strong as the wire of which it was made. Finally, after some trials, splices like that shown in fig. 4 were formed and it was found that the wire would break before a splice of this type failed. In fig. 2 the "end-turns" of a splice are indicated; the neck is the portion of the splice between the end-turns. In the type of splice shown in fig. 1 the neck is not twisted; when it is subjected to tension the end-turns first pull together along the main wires and finally unwrap, and the two spliced wires usually pull entirely apart. In fig. 3 a splice is shown which is frequently called the American telephone joint; it has a short neck

FIG. 1.

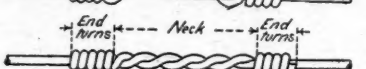


FIG. 2.

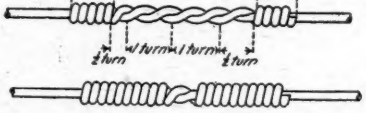


FIG. 3.

containing one turn and a number of end-turns varying with the maker of the splice. The idea appears to be prevalent among linemen that the strength of a splice is dependent almost wholly on the number of end-turns it has, and that the number of turns in the neck is of little consequence. It was shown by tests that this idea is erroneous. As tension is applied to a joint like that of fig. 3, it will untwist entirely, or often, partially untwisting one of the wires, will break at a load considerably less than the full strength of the wire. Tests were made to ascertain the effect of increasing the number of turns in the neck. Several sample splices were made, each having but two end-turns, but the number of turns in the neck was made different in each case. Each of these splices were tested to failure. The results of the tests show that if a joint has five turns in the neck the full strength of the wire composing it will be developed. Fig. 4 shows a joint having five turns in the

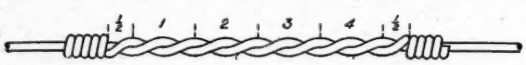


FIG. 4.

neck, which is as strong as the wire of which it is made. The length of neck in each case should be such that it will just safely contain five turns. If the turns be made too short, the wires will be "burned" in twisting the splice, and if the turns be too long their power of resistance will not be a maximum. It was found that proper neck lengths to contain five turns safely for different gauges of wire were about as follows:—No. 14 wire, 3½ in.; No. 12 wire, 3¾ in.; No. 10 wire, 4 in.; No. 8 wire, 6 in.; and No. 6 wire, 7 in. Although five end-turns are shown in the illustration of the typical safe joint, fig. 4, the tests indicate that two are ample. A joint having five end-turns has a better appearance than one having two, hence five is suggested as a standard number. A few soldered joints were tested, and it was found that almost any joint if soldered would develop a strength greater than that of the wires composing it.

Private Meeting.—GEARY, ADAMS & CO., electrical engineers, Wolverhampton.—A meeting of the creditors of the above was held a few days ago, when a statement of affairs was presented showing liabilities of £313. The indebtedness to the trade was £213, and the balance of £100 was in respect of a cash claim. The assets were estimated to realise £33, and a deficiency was thus disclosed, as regarded the unsecured creditors, of £280. As regarded the contributors, there was a deficiency of £1,280 4s. 10d. It was reported that the company was formed in August of last year to take over the business which was formerly carried on by Mr. F. C. Geary. The business was said to be that of electric installation and general engineers, but it appeared that the company had only secured three contracts of any magnitude during the whole of the trading. Certain difficulties had arisen in regard to the contracts, and it was for this reason that the doubtful book debts were large and had been drastically written down. A debenture for £30 was issued, and in March of the present year the debenture-holder appointed a receiver. Between August and December of last year the turnover was in the neighbourhood of £1,300, while between January 1st and March 18th of the present year the sales were about £160. The Receiver had been since carrying on the business, and had completed the contracts. He had discharged the debenture, and there was a balance in hand of £6 odd. After a short discussion, the creditors decided to confirm the appointment of Mr. Parker as the voluntary liquidator of the company.

Joint Conference of London Electric Supply Authorities.—The Joint Conference of London Electric Supply Authorities held a meeting at Cannon Street Hotel, on December 1st, which, we are informed, was well attended. Mr. Ernest Debenham (Mayor of St. Marylebone) occupied the chair, in the absence through illness of Mr. W. F. Fladgate. An interim report of the Executive Committee of the Conference was submitted, approved and adopted. This interim report dealt with the extensive work which had been carried out during the past year by the Executive Committee, assisted by the Joint Engineers' Committee, in setting out the bases of a linking-up scheme under the London Electric Supply Act, 1908. Reference was made to the valuable information of a confidential character which had been collated by the Joint Engineers' Committee, bearing on the question of the supply of London, and upon which the engineers are still engaged. The Executive Committee was unanimously reappointed. A resolution was passed expressing appreciation of the work of the Electric Supply Publicity Committee, and it was unanimously decided that the members of the Conference should subscribe a substantial amount to the funds of the Publicity Committee, on a revenue basis, for the purpose of their developing a still more vigorous advertising programme.

Sewing Machine Motors.—According to the *Sewing Machine and Cycle Gazette*, there is in London a possible sale for 50,000 motors for sewing machines, provided that they be sold on instalment terms, and be properly affixed to the machines so as to ensure success.

How to Advertise Gas.—In its last issue our contemporary, the *Gas World*, devotes a column and three-quarters to an attack upon ourselves, because we accused it of "hardihood" in our issue of November 18th. We are charged with levelling "abuse" at the doctor to whose remarks we referred, though, as we hardly need say, we had no intention of abusing him or anyone; and our expression of belief that the adoption of gas in two rooms of the Society of Medical Officers of Health was a matter of advertisement is called "quite mildly, a terminological inexactitude." It will be remembered that we challenged the production of proof that gas had not been put in merely as an advertisement; no such proof is yet forthcoming, but our contemporary says, "we have authority for saying that the work was carried through on an entirely commercial basis, and will be, if it has not already been, duly paid for in coin of the realm." As for this, we happen to be aware that a well-known electrical firm was invited by a representative of the Society to install its apparatus on the premises "for the sake of the advertisement," but the proposition was declined.

We are enjoined to set ourselves right with our readers and with the *Gas World*. But are we wrong? An attempt to have our challenge referred to the General Purposes Committee of the Society for consideration and report was objected to by the chairman of the Committee which supervised the new heating, lighting and ventilating arrangements, as beneath the dignity of the society, and was rejected by a large majority; the proceedings are quoted at length by our contemporary, but they throw no light on the transaction. The *Gas World* makes the most of the statement of the chairman that a great improvement had taken place "since gas had been substituted for the electric light, and the new system of heating and ventilation had been installed." But let it be remembered that gas *plus ventilation by electric fans* has been substituted for electricity *without proper ventilating arrangements*. Is this a fair comparison? In the words of the doctor whose remarks were referred to, "an ill-ventilated gas-lit office may so depress the heart, even when organically sound, that the pulse becomes feeble and intermittent and life miserable and useless." Any ill-ventilated office—or meeting-room—will produce the same effects, no matter what the mode of lighting, and what we object to is the claim that the improvement is due to the substitution of gas for electricity, whereas it is the ventilation by electric fans that has effected the improvement—a claim which our contemporary has the h— courage to repeat.

Church Wind-Turbine Plant.—Cosely Church, near Bilston, is now lighted throughout by electricity provided by one of Messrs. J. G. Childs's (of Willesden Green, London, N.W.) patent wind-turbine electrical plants; in addition, the organ is blown by means of an electric motor supplied from the same source. The plant in question has a turbine wheel 18 ft. in diameter, which is placed upon a tower 60 ft. in height, erected some 200 yards away from the church, upon the tailings of a disused coal mine. There are 27 25-C.P. lamps in the church, two in the side chapel, and two in the vestry; and in the vicarage there are about 30 lights. The church lights and the organ run at 50 volts, and the vicarage lights at 25 volts, from a 28-cell battery; and the whole arrange ment works most satisfactorily. The power from the turbine is transmitted by a vertical steel shaft to the generator housed in a shed at the foot of the tower. The generating plant is quite automatic in action, and governs itself, being fitted with the makers' patent tail-governing gear, which enables the maximum amount of power to be taken out of the wind up to the normal capacity of the plant. When this point has been reached, the patent arrangement takes the wheel out of the wind, more or less, as the strength of the wind increases. The generator is of Messrs. Childs's special type. These wind-turbine plants are quite out of the experimental stage, and there are now a good number running in this country and abroad for country house lighting, &c. Though the first cost is slightly in excess of that of a gas of oil-engine plant, the small extra cost is soon more than saved by there being no running expenses. The whole installation in this instance cost about £200. The plant needs no skilled mechanic to operate it, and about half an hour per week suffices for the attention requuired, which can be given by an ordinary labourer, gardener, or odd man.

An Echo of Competition in Germany.—A striking example of one of the results of severe competition in Germany is afforded by the position of Ernst Heinrich Geist Elektrizitäts Aktien Gesellschaft, of Cologne. This particular company has for a long time past stood in the foreground in the fight against the supremacy of the large firms, and by appealing to the public it has sought to defend itself against the growing monopoly of the large manufacturers. But all these endeavours have been in vain, and the company is likely to succumb to superior forces, as the directors now propose that the undertaking should go into liquidation. The report for 1909-10, whilst recording a large volume of business, as dynamos, motors and transformers alone increased by 25 per cent., states that prices again declined as compared with the previous year by over 20 per cent., and competition has become so keen that orders can only be obtained at a great sacrifice. After absorbing the reserve fund of £2,100, the year has closed with a deficiency of £6,060. In itself this loss is not considered to be sufficiently large to render it advisable to enter into liquidation. As, however, manufacturing at the present low prices results in a loss, and as an increase in prices is not to be expected within a conceivable period, the directors deem it necessary to place the question of liquidation before the forthcoming general meeting with the object of obviating larger losses. It is believed that no reason for uneasiness exists, as the assets will more than suffice to satisfy all the creditors under the assumption of a quiet settlement. The unfavourable results for 1909-10 are all the more depressing for the company inasmuch as the previous year ended without any profits, whilst the year 1907-8 involved a loss of £7,900 and a reorganisation of the company's capital.

The Electric Safety Boiler Cleaner.—On Friday last, through the courtesy of the Electric Safety Boiler Cleaner, Ltd., of 6, Lloyd's Avenue, Fenchurch Street, E.C., we were enabled to inspect an interesting device—the invention of Mr. Adolph Schror, of Bremen—for cleaning the scale from the interiors of boilers. This apparatus consists simply of a ½-H.P. motor coupled by means of a flexible shaft to a special milling tool, which, rotating at a high speed, practically grinds off the scale in the form of dust. The speed can be varied from 1,300 to 4,000 R.P.M., and it is claimed that this high speed does away with labour on the part of the operator, who has simply to hold the tool against the plate and guide it by means of the handle provided. The hammer and chisel method of scaling a boiler is admittedly an inefficient one, as in awkward positions, such as inside Galloway tubes and in narrow water spaces, it is practically impossible to work on the plates by hand. The electric cleaner, however, can be manipulated in any out-of-the-way corner, and the interior cleaned down to the plate surface, without in any way injuring the latter, as might be the case if chipping were resorted to. The cutting tool, it may be mentioned, consists of several interchangeable cutter disks, which can be varied as to spacing and diameter, in order to facilitate working in narrow places, as between rivets and on the rounded interiors of tubes, &c. The company claims that it is possible by means of the machine to clean completely a Lancashire boiler of any type in from three to five days. The apparatus was shown in use on one of the boilers in the basement of the Hotel Metropole, two of the boilers having already been cleaned to the satisfaction of the National Boiler and General Insurance Co., Ltd., who have approved the apparatus. We also gather from numerous testimonials that the device has met with considerable success in Germany, and that it will shortly be available in a modified form for use in water-tube boilers.

Institution and Lecture Notes. — Institute of Marine Engineers.—On November 28th Mr. W. P. Durtnall read the second half of a paper on "The Internal Combustion Engine." The author described minutely the various details of an internal-combustion engine using oil as fuel, and drew attention to the fact that quick-revolution engines exhausted their gases at fairly high pressure; such gases, he thought, could be used to drive low-pressure gas turbines. The internal-combustion engine has only one speed at which the maximum of work can be performed with the least amount of fuel. This, he thought, pointed to electricity being necessary as the link between the gas engine and propellers. He suggested that in the large internal-combustion engines of the future, the automatic control of the valves, the moment of lift and time remaining open, &c., would be controlled by electrical means. An interesting method of firing the gases by a high-resistance conductor which formed part of the secondary of an alternating transformer was shown. This got over the difficulty of sparking plugs, and the incandescing of the resistance bar could be timed very accurately. A gas producer to use either crude oil or coal as fuel was described, and Mr. Durtnall pointed out that this would meet the objections raised to gas engines on board ship on account of a particular coal being required. By using this new form of producer, oil could be used when coal was not available. The author also showed the remarkable propeller invented by Vozacek, an Austrian engineer, the rights of which the author now controls. This propeller rotates horizontally instead of vertically, as an ordinary screw propeller does. It has two blades, which feather by means of a sun and planet motion, so that the blade which is doing the work for the time being gives a direct thrust on the water. The propeller gives practically no wash, and being deep down in the water it is much more effective for a given blade area and number of revolutions than is the ordinary screw propeller. The propeller acts perfectly as a rudder, and the simple movement of a steering wheel causes the pinion of the sun and planet motion to alter the relative position of the blades. The propeller can thus be made to move the boat backward or forward, or push the stern to right or left.

Mr. E. Kilburn Scott, in opening the discussion, agreed that as the internal combustion engine ran best at one definite speed, electric transmission was necessary to link it up with propellers which must necessarily run at many speeds. On warships the question of smoke was a most important one, and as anthracite was not always available, it was highly important to give consideration to a prime mover that worked without smoke, whatever the fuel might be. As far as the engine was concerned, the keystone of the whole matter seemed to be the gas-producer. There were plenty of good engines, and their theory and construction were thoroughly understood, but the gas-producer was not half worked out. This was shown at Johannesburg, where the main trouble was in the gas producers. The simplest solution was to do away with the gas producer altogether, and use the crude oil direct in a Diesel engine having a very high compression. The interesting horizontal propeller, with feathering blades, also pointed in the direction of electric propulsion, as the propeller spindles must of necessity be driven by vertical type electric motors.

Coventry Engineering Society.—An address upon "Electricity Applied to Mining" was given, on November 25th, by Mr. C. F. Jackson, manager of the Eshall Colliery, Warwickshire. He said that many mining engineers preferred the D.C. system at 500 to 600 volts, and this was doing excellent service. Of the various kinds of cable he had a decided preference for vulcanised bitumen double-wire armoured. The cables should be cased in iron pipes or in wooden troughs well tarred, as pit water, being acid, was very destructive. At Eshall Colliery they used two cables, so that if anything went wrong with one they could change over to the other. He preferred double-armoured cable, properly earthed, because the moment the armour and the copper came together there was such a rush of current through the short that the circuit-breakers broke the circuit immediately. The Lahmeyer plate ventilated motor, which was in use in Germany, had not been looked upon favourably in England by the Inspectors of Mines, though he regarded it as perfectly safe, and believed it would ultimately come into operation in this country. In the use of electricity for shot firing, he favoured low-tension fuses, but wished someone would invent a fuse that could be fired without a detonator. In holing out the end of a seam, electrically-driven cutters had reduced the percentage of slack by 20 per cent., and there was also much labour saved by electrically-driven chain conveyors for bringing the coal from the coal face to the main roads. In the last five years there had only been 58 fatalities in mines due to electricity, or less than 1 per cent.; thanks to its safety, adaptability, economy and efficiency, it was the best friend they had in underground work if proper care and supervision were exercised.

Royal Institution.—The following are among the lecture arrangements before Easter:—Prof. Silvanus P. Thompson, a Christmas course of six illustrated lectures on Sound, Musical and Non-musical, a course of Experimental Acoustics, adapted to a juvenile auditory: (1) Production of Sound; (2) Transmission of Sound; (3) Reception of Sound; (4) Combination of Sounds; (5) Registration of Sounds; (6) Reproduction of Sound. Prof. Sir J. J. Thomson, six lectures on Radiant Energy and Matter. The Friday evening meetings will commence on January 20th, when Prof. Sir James Dewar will deliver a discourse on Chemical Change at Low Temperatures. Succeeding discourses will probably be given by Prof. W. H. Bragg, Prof. H. E. Armstrong, Prof. H. S. Hele-Shaw, Prof. Sir J. J. Thomson, and other gentlemen.

At a meeting of members held on 5th inst., Prof. Jules Henri Poincaré (Paris) and Prof. Alexander Graham Bell (Washington) were, with several others, elected honorary members of the Institution.

The Aluminium Industry.—It is extremely difficult to fathom the actual situation of the aluminium industry from the international point of view, as reports and contradictions rapidly follow one another. The recent negotiations for the formation of an international syndicate are now declared to have failed owing to the attitude assumed by the American works. On the other hand, reports from Paris allege that in consequence of the collapse of the international scheme, all the French producers of aluminium have combined together for a number of years for home and export business to be conducted on common account. As the total productive capacity of the French works already amounts to about 15,000 tons per annum, it is contended that this group will be a determining factor in connection with any possible renewal of negotiations for an international syndicate. The French works are protected in the home market by the operation of a fairly high import duty, and it is considered from this point of view that their competition in the world's markets must be esteemed all the more. It is stated that the sales business for the whole of the French works has been placed in the hands of the Metal Co., of Frankfort-on-Main. The Paris report is, however, sought to be discredited by a Cologne newspaper, which points out that the French producers have always been at variance, and, therefore, suggests that the rumoured combination is scarcely credible. It is considered to be more probable that the three largest works in the world—the Neuhausen Co., the British Aluminium Co., and the Aluminium Works, of America—have combined, as the quality turned out by them is said to be the best, and as their united output is almost 40,000 tons per annum, the production of the French works would not play any great part in international markets.

Appointments Vacant.—Assistant engineer for the chief electrical engineer's department in a leading railway company abroad (£750); canvasser for the Hampstead B.C. electricity department (£200); burgh electrical engineer for Oban. See our advertisement pages in this issue.

Bristol Corporation Electricity Undertaking.—In order to meet the public convenience and facilitate the general administration of the various departments of the Bristol Corporation electricity undertaking, the engineer's offices, secretary's offices, and the Colston Street showrooms have now been centralised. In future the whole of the management, including the accountancy, the publicity department and the receipt and payment of accounts will be carried on under the personal direction of one head (Mr. H. Faraday Proctor), at The Exchange, Corn Street, and all communications should be addressed "The Manager" at that address. A commodious showroom is being equipped, where a stock of lamps, fittings and appliances will be on view.

Electrical Apparatus in Mines.—Before Sheriff Macleod, in Linlithgow Sheriff Court, Scott Lees, mine manager, was charged with having, on June 20th last, failed to maintain the electrical apparatus in the Douglas Dook, Dalmeny Mine, belonging to the Dalmeny Oil Co., Ltd., in such a condition as to reduce the danger through accidental shock to a minimum. A solicitor, who appeared for respondent, explained that the condition was due to a sudden "creep" in the workings, and the management, although desirous of adopting all necessary precautionary measures, were prevented from doing so by the "creep" referred to. He stated further that eventually the whole place crept in and the machinery was lost. In the circumstances, his Lordship imposed a fine of £2.

The A.E.G. New Director.—The Berlin correspondent of the *Standard* says that a report was current there on Wednesday night that Herr von Dernburg, the ex-Colonial Secretary, who has just returned from the Far East, has accepted, or is about to accept, a seat on the board of directors of the Allgemeine Electricitäts Gesellschaft, with a view to becoming its president when the present occupant, Herr Emil Rathenau, who is over 70 years of age, retires. It is also stated that Herr von Dernburg's programme as controller of this gigantic concern would include the gradual substitution of electricity for steam as the motive power on all the German State railways.

The Electrical Committee and Municipal Wiring.—On Wednesday evening the Electrical Committee met at the I.E.E. to discuss the question of municipal powers for hiring and wiring. The meeting was a small one, under forty being present, and owing to the fact that the Conference, which is endeavouring to adjust matters between the contracting and supply interests, is still sitting, the few representative members who were present had necessarily to be content with generalities.

Thanks to the genial and persuasive chairmanship of Mr. Robert Hammond, some discussion took place, and one was enabled to gather that the Conference, at any rate, is likely to end satisfactorily. Among those present were Messrs. E. Garcke, J. S. Raworth, G. Harland Bowden, W. A. Vignoles and A. A. Campbell Swinton.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Central Station Officials.—The staff of the Ilford electricity works has presented a marble clock to MR. T. O. REYNOLDS, on his marriage.

MR. T. A. ETHERINGTON has resigned his position as shift engineer at the Stockton-on-Tees Corporation electricity works, to take up the position of engineer-in-charge at the Prestwich Asylum. MR. S. BROWN, of the Middlesbrough Corporation electricity works, has been appointed to fill the vacancy.

MR. C. M. DAVIS, of the Tynemouth electricity department, has received the appointment of engineer and canvasser in the Bristol Electricity Supply Publicity Department, and MR. T. B. STODDART, at present with Messrs. Wm. Drysdale & Co., contractors, Duke Street, Barrow-in-Furness, and formerly with the Edison & Swan United Electric Light Co., Ltd., of Newcastle-on-Tyne, has been appointed as showroom attendant.

General.—The *Review of the River Plate* states that the local board of the Rosario Electricity Co. (Belgian) has been appointed as follows:—MR. F. H. CHEVALLIER BOUTELL, chairman, and MR. J. PEDRIALI, manager of the Anglo-Argentine Tramway Co.

At a smoking concert held at Stafford on 30th ult., MR. C. M. TOPLIS, chief draughtsman to Messrs. Siemens Bros. Dynamo Works, Ltd., was presented by the staff with a gold watch and chain. Mr. Toplis, who will shortly take up a responsible post with Messrs. Stothert & Pitt, carries with him the good wishes of a large circle of friends.

Obituary.—MR. MALCOLM SUTHERLAND.—Mr. Malcolm Sutherland, burgh electrical engineer, of Oban, died suddenly on 29th ult., in his forty-seventh year. Mr. Sutherland early joined the firm of Messrs. Muir, Mavor & Coulson, and was the first engineer in charge of a generating station for public supply in Glasgow. He superintended the running of the overhead mains in connection with the Glasgow supply at that time. Mr. Sutherland was later retained by Messrs. Denny & Co., of Dumbarton, and advised them with regard to the electric lighting and equipment of several large vessels built in their yard. Proceeding to London, he became a partner in a firm which specialised in the manufacture of small accumulators. Some years ago he returned to Scotland, and worked as a mains superintendent with the Clyde Valley Power Co. Four years ago he was appointed burgh electrical engineer at Oban, where he was attracted by family reasons.

MR. J. H. WRAY.—The interment took place at Blackpool Cemetery, on November 30th, of Mr. John Harold Wray, aged 32 years. Deceased was one of the first employés in the Blackpool Corporation Electricity Department, going there at the age of 14. Four or five years later he went out to Malaga, Spain, as an assistant electrical engineer, and there he remained for three years, when he was attacked by malarial fever. Returning to England, he spent 12 months at Folkestone, and then came back to Blackpool, where he was under Mr. Quin, who was then borough electrical engineer. Later he secured an appointment as electrical engineer for the county borough of West Bromwich, and he filled the office for five years. He was offered a lucrative position in Bombay, but, acting on medical advice, he did not take it up. For the past few years he had not, owing to health reasons, followed his calling, but had managed his father's business.

HERR RUDOLF WOLF.—We regret to announce that Herr Rudolf Wolf, the founder of the well-known locomobile works in Magdeburg-Buckau, died on November 20th, at the age of 79 years. Herr Wolf, by the successful application of superheated steam and development of the locomobile into a high-class steam power plant achieved a remarkable success in that department of engineering.

MR. T. PARKER.—The death has occurred at Abbey Wood, after a short illness, of Mr. Thos. Parker, traveller for Callender's Cable and Construction Co., Ltd., of Belvedere, in whose service he had been for over 25 years. He was 46 years of age, was a prominent Freemason, and had recently returned from Buenos Ayres.

NEW COMPANIES REGISTERED.

Britannia Import Co., Ltd. (112,988).—This company was registered on December 1st, with a capital of £500 in £1 shares, to take over the business of electricians, &c., carried on by F. Frohwein, at 87, Tabernacle Street, E.C., as the Britannia Import Co. The subscribers (with one share each) are:—F. Frohwein, 87, Tabernacle Street, E.C., electrician; H. Stampf, 93, Aldersgate Street, E.C., glass importer; T. Challing, 45, North Birkbeck Road, Leytonstone, merchant tailor; I. Frohwein, 27, Wiesbaden Road, Stoke Newington, N., importer. Private company. The number of directors is not to be less than two or more than five; the first are F. Frohwein and I. Frohwein. Qualification, £10; remuneration, £20 per annum. Registered office, 87, Tabernacle Street, E.C.

Electric Train Lighting Syndicate, Ltd. (112,932).—This company was registered on November 28th, with a capital of £5,200 in £1 shares, to acquire certain patents relating to the lighting of trains, tramcars and other vehicles by electricity. The subscribers (with one share each) are:—R. G. Sharp, 63, Cowper Street, Leeds, engineer; R. W. Storey, 151, Brudenell Road, Leeds, secretary. Private company. The number of directors is not to be less than three or more than five; the first are T. Ferguson, F. L. Lane, R. G. Sharp and R. W. Storey. T. Ferguson may retain office while holding £1,000 shares. Qualification of ordinary directors, £400. Registered by Jordan & Sons, Ltd., 116-117, Chancery Lane. W.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Lyme Regis Electric Light and Power Co., Ltd. (101,894).—Agreement and debenture bond dated November 5th, 1910, to secure all moneys due or to become due from company to Lloyd's Banking Co., Ltd., 71, Lombard Street, E.C., not exceeding £600, charged on the company's undertaking and property, present and future, including uncalled capital.

Foote & Milne, Ltd. (73,923).—Particulars of £5,000 second debentures, created November 10th, 1910, filed pursuant to Sec. 93 (3) of the Companies (Consolidation) Act, 1908, the whole amount being now issued. Property charged: The company's undertaking and property, present and future, including uncalled capital. No trustees.

Drake & Gorham, Ltd. (70,275).—Return dated November 8th, filed November 10th, 1910. Capital £125,000 in £1 shares; 125,000 shares taken up; £85,000 paid; £40,000 considered as paid. Mortgages and charges: Nil.

Auckland Electric Tramways Co., Ltd. (61,199).—Return dated May 16th, filed August 26th, 1910. Capital, £400,000 in £1 shares (50,000 preference); all shares taken up; £1 per share called up on 335,100 ordinary, and 50,000 preference; £285,100 paid; £14,900 considered as paid on 14,000 ordinary. Mortgages and charges, £325,582.

Monte Video Telephone Co., Ltd. (27,208).—Return dated November 8th, filed November 15th, 1910. Capital, £160,000 in £1 shares (87,000 preference); 86,492 preference, and 72,680 ordinary shares taken up; £159,172 considered as paid on 86,492 preference and 72,680 ordinary. Mortgages and charges: Nil.

African Transcontinental Telegraph Co., Ltd. (37,855).—Return dated November 7th, filed November 11th, 1910; capital £300,000 in £1 shares; 226,850 shares taken up; £1 per share called up; £225,855 paid, leaving £995 in arrears; £10 paid on 20 shares forfeited. Mortgages and charges: Nil.

Cleveland and Durham Electric Power, Ltd. (89,539).—Return dated October 21st, filed October 27th, 1910; capital, £1,000,000 in £5 shares (70,000 preference, 70,000 ordinary and 60,000 deferred); 66,741 preference, 32,111 ordinary and 59,392 deferred shares taken up; £5 per share called up on 66,367 preference and 19,767 ordinary; £430,770 paid; £360,450 considered as paid on 354 preference, 12,344 ordinary and 59,392 deferred, except £6 5s. paid in cash. Mortgages and charges: £225,500.

Direct West India Cable Co., Ltd. (53,956).—Return dated October 6th, filed October 7th, 1910. Capital £120,000 in £5 shares. 12,000 shares taken up. £2 10s. per share called up. £30,000 paid. Mortgages and charges; £36,000.

Halifax and Bermudas Cable Co., Ltd. (28,972).—Return dated October 6th, filed October 7th, 1910. Capital £50,000 in £5 shares. All shares taken up. £50,000 considered as paid. Mortgages and charges: Nil.

Nairobi Electric Power and Lighting Co., Ltd. (87,728).—Return dated October 12th, filed October 15th, 1910. Capital £30,000 in £1 shares (12,000 preference). 12,000 preference and 7,100 ordinary shares taken up. £19,000 paid. £100 considered as paid. Mortgages and charges: £11,800.

Hobart Electric Tramway Co., Ltd. (35,926).—Return dated October 19th, filed October 26th, 1910. Capital £105,000 in £1 shares. 50,310 shares taken up. £25,790 paid. £24,520 considered as paid. Mortgages and charges: £56,245.

City of Oxford Electric Tramways, Ltd. (91,106).—Debenture dated November 18th, 1910, to secure £55,000, charged on the company's undertaking and property, present and future, including uncalled capital. Holders: Oxford Tramways, Ltd., Queen Anne's Chambers, Westminster.

Gilbert Little Co., Ltd. (84,194).—Legal mortgage on freehold land and premises known as "Horton Iron Works," Bradford, to secure all moneys due, or to become due, from company to London, City and Midland Bank, Ltd., 5, Threadneedle Street, E.C.

CITY NOTES.

British Columbia Electric Railway Co., Ltd.

THE directors' report for the 12 months to June 30th, 1910, states that the gross receipts show an increase of $730,492, or 31 per cent., and the net earnings, including income from investments and subsidiaries, and after charging renewals, show an increase of $176,341, or 19 per cent., over the preceding year. From June 30th, the close of the financial year under review, up to October 31st last, there has been a still further increase in gross earnings of $279,950, or 29 per cent., and in net earnings of $77,281, or 17 per cent. The following charges have been made against the revenue account of the year, viz.:—Provision for renewals maintenance (from which £15,242 has been deducted for adjustments and expenditure on renewals during the year), £46,426; special provision against depreciation in value of certain obsolete steam plant, £3,000; bonus to employés £11,333, amount added to capital amortisation fund £2,099. The net profit for the year, after making the above deductions, amounts to £198,870, plus £7,061 brought forward, making £205,931. The following are deducted:—Interest on debentures and debenture stock to June 30th, 1910, £59,479. Dividends already paid:—On 5 per cent. cumulative perpetual preference stock for year ended June 30th, 1910, £25,000, on preferred ordinary stock for year ended June 30th, 1910, £30,000; on deferred ordinary stock for six months to December 31st, 1909, £24,000=£138,479, leaving available for further distribution and reserves, £67,452. From this the directors have decided to recommend the payment of a dividend on the deferred ordinary stock at the rate of 8 per cent. per annum for the six months to June 30th, 1910, making 8 per cent. for the year, £24,000; to transfer to reserve fund, £37,845; and to carry forward £5,607. There has been deducted from the reserve fund the sum of £18,531, representing the difference between the net amount realised by, and the par value of, £530,000 4½ per cent. debenture stock, issued in February last, and there has been added to the reserve fund £39,584, representing the premium on £500,000 new capital, less expenses, issued in September, 1909. After the transfer now recommended, the reserve fund will amount to £235,000. The number of lamps in use at June 30th, 1910, was 439,315, an increase for the year of 92,289. The number of passengers carried during the year was 34,476,804, an increase for the year of 9,293,065.

The commercial conditions at present existing in Vancouver and the prospects for the future have been carefully examined by the directors, who report that the information at their disposal, obtained from reliable sources, indicate the existence of a sound basis for the undoubted prosperity which at present prevails throughout the whole province and gives promise of its continuance in the future. A number of figures are given to illustrate the growth and prosperity of Vancouver generally.

The report then continues: "The rapid development of the territory, and the great increase in the population of the cities served by the company, have made it necessary for your directors to give the most careful consideration to the question of the future supply of power, and in this connection Mr. Buntzen kindly undertook a special mission to British Columbia to investigate the entire situation and consider on the spot the recommendations previously received from the management. Early in the present year it was decided to increase the capacity of the auxiliary steam plant in Vancouver, which provides for sudden temporary demands for extra power and a reserve in case of a breakdown on the transmission line or at the hydraulic plant. The work of increasing the capacity of the water-power installation at Lake Coquitlam, referred to in last year's report, has also been continuously pushed forward, as has also the new water-power installation at Jordan River, near Victoria. On the recommendation of the company's engineers, entirely endorsed by Mr. Buntzen and the management, a scheme has been sanctioned by your directors by which the power supply of the company can be gradually increased to meet any possible demands of the future. The addition to the Vancouver steam plant was satisfactorily completed in April last, and it is confidently expected that the enlargement of the Coquitlam water tunnel and the new Jordan River plant will be completed early in the year 1911. The other plans include the gradual development of the company's water powers at Chilliwack and Jones Lake, and the systematic proportionate increase of the auxiliary steam plant. Altogether the plans provide a total ultimate supply of about 200,000 continuous horse-power. The Fraser Valley line was formally opened from New Westminster to Chilliwack, a distance of 65 miles, by the Hon. Richard McBride, Prime Minister of British Columbia, on October 3rd, 1910. The road and electrical equipment of this line have been constructed in a permanent and efficient manner, and the freight and passenger traffic already secured is very satisfactory. A considerable mileage of preliminary track has, during the year, been replaced by heavy permanent construction, and extensions, aggregating about 21 miles, have been constructed, or are in process of construction, in the territory between Vancouver City and New Westminster City and the Fraser River estuary. These branch lines are required to give necessary transportation facilities to the inhabitants of this district, which is developing with great rapidity, and, although they are not expected to prove immediately remunerative, your directors are satisfied they will, in the course of a few years, prove valuable sources of revenue. In addition to the foregoing, the company has incurred considerable expenditure as a result of the extension of the lighting branch of your undertaking, the provision of increased rolling stock, particularly for the Fraser Valley line, and further land, buildings and electrical equipment rendered necessary by the growth of the business. Your directors view with particular satisfaction the completion of the Fraser Valley branch and the approaching completion of other extensions, and of the Coquitlam water tunnel and the Jordan River water-power plant, as, for the past two years during construction a very large sum of money has been unremuneratively locked up in these enterprises, which may be expected to contribute substantially to the company's revenue for the future. The larger portion of this money appears in the accounts under the heading of "Loans and investments," and the low yield of interest and dividends on loans and investments is thereby mainly accounted for. The directors have again pleasure in expressing their appreciation of the very satisfactory services rendered by the management and staff in British Columbia."

The directors record the death of their colleagues, the Hon. M. R. Gifford and the Hon. R. G. Tatlow. Mr. A. C. Mitchell-Innes has found that his business engagements render it impossible for him to take up his residence in England, and his resignation has, therefore, been accepted by his colleagues. The two vacancies thus created have been filled by the appointment of Mr. Harold G. Brown and Mr. E. Maes Harvey. The following is a comparative statement:—

Year ended June 30th.	Gross earnings.	Net revenue.	Passengers.	Lamps in use.	Balance available for div.	Pref. ord. stock, div.	Defer. ord. stock, div.	Added to reserve.
1908 ..	£408,105	£180,431	21,328,180	287,624	£120,998	6%	8%	73,274
1909 ..	478,146	190,444	25,183,739	347,026	123,417	6%	8%	65,095
1910 ..	628,763	226,809	34,476,804	439,315	159,391	6%	8%	108,265

The meeting is to be held at Abercorn Rooms, Liverpool Street Hotel, E.C., on December 19th, at 12 o'clock. A resolution will be submitted for increasing the capital to £3,200,000 by the creation of 700,000 new shares of £1 each.

Eastern Extension, Australasia and China Telegraph Co., Ltd.—The directors have declared an interim dividend for the quarter ended September 30th last of 2s. 6d. per share, free of income-tax, payable on the 14th prox.

Western Telegraph Co., Ltd.—The directors have declared the first quarterly interim dividend of 3s. per share, free of income-tax, for the year ending June 30th, 1910, being at the rate of 6 per cent. per annum. The transfer books will be closed from December 14th to 20th.

Sao Paulo Tramway, Light and Power Co., Ltd.—The directors have declared a quarterly dividend of 2½ per cent. on the capital stock.

Siemens-Schuckert Groups.

THE customary summaries of the financial results for the past year, pending the forthcoming issue of the annual reports for 1909-10, have just been published by the directors of three of the undertakings associated with the Siemens & Schuckert groups. It is stated that the balance-sheets have been prepared with special care having regard to the future development of the electrical industry, this meaning that before net profits were struck, a certain sum was devoted to secret depreciation, at least in the case of two of the companies. The total results for 1909-10 are regarded as wholly satisfactory, and the new financial year has witnessed a considerable increase in business. The following figures for the two years are reproduced from the summaries:—

SIEMENS & HALSKE CO.

	1909-10.	1908-9.
Net profits	£575,000	£571,000
Placed to reserve funds	75,000	75,000
Bonuses to staff, &c.	35,000	32,500
Disposition fund	17,500	17,500
Dividend	378,000	378,000
„ per cent.	12	12
Carried forward	53,000	51,000

SIEMENS-SCHUCKERT WORKS.

Net profits	£530,000	£513,000
Bonus to staff, &c.	50,000	42,500
Disposition fund	17,500	17,500
Dividend	450,000	450,000
„ per cent.	10	40
Carried forward	12,600	3,300

ELEKTRIZITATS GESELLSCHAFT VORM SCHUCKERT.

Gross profits	£326,000	£310,000
Net profits	260,000	226,000
Placed to special reserve fund ...	15,000	—
Dividend, per cent.	7	6
Carried forward	61,900	60,600

It will be seen that, as was foreshadowed a short time ago, the Siemens & Halske Co. has abstained from following the example of the A.E.G. in increasing the rate of distribution which remains at 12 per cent., as in 1908-9, and which compares with 11 per cent. in each of the two preceding years. The disposition fund, it is well to explain, is also in favour of the staff and the workmen. The Schuckert Co., of Nuremberg, on the other hand, propbses to pay a higher dividend for the year, and thus fulfils the Stock Exchange expectations. At present no information is available as to any prospective augmentations in the capital of the companies in question.

Adelaide Electric Supply Co., Ltd.

THE sixth annual general meeting of the above company was held on Monday at the offices, Finsbury Pavement House, E.C., Mr. J. B. Braithwaite presiding.

In moving the adoption of the report (see ELEC. REV., p. 917), the CHAIRMAN said that the profit for the year showed a credit balance of £42,238, which compared with about £25,000 last year, a very substantial improvement. Their progress had continued to be extremely satisfactory. They had now extended their mains to Guenelg, a suburb of Adelaide, where many people resided. So far as motors were concerned, on August 31st they had an equivalent of 3,101 H.P. connected as against 2,369, showing an increase of between 600 and 700 H.P.; and they had 112,154 lamps connected as against 91,338, or an improvement of about 19,000 lamps. There was an improvement of close on half-a-million units in the current sold. In the balance-sheet they would see the changes which had taken place in the capital account to provide for the various extensions. Last year their capital stood at £280,325, and during the year they had issued the remainder of their ordinary shares, so that their capital now stood at the full amount of £300,000—£150,000 preference, and £150,000 ordinary; on the credit side of the account the cost of the undertaking had gone up from £292,030 to £330,420, an increase approximately of £38,000. Stores in Australia had risen from £6,541 to £9,608; sundry debtors in Australia had risen from £6,404 to £8,175; and the cash at bankers and in hand was about the same. From the revenue account they would see that the receipts from the private supply for lighting had been £29,339, against £24,091, an improvement of about £5,000. For the supply of power and apparatus the receipts were £10,324, against £8,618, and for public lighting £1,946, against £1,759. The supply to the Municipal Tramways Trust had risen to £32,650, due to the fact that they had operated the whole of their system for the year. Motor rents were £1,097, against £790. The total receipts were £75,595, against £43,462, which was an improvement of about £32,000. On the other side the generation of electricity had risen from £10,126 to £21,984; distribution from £2,346 to £2,535; repairs and renewals from £2,878 to £3,374; and general charges from £2,885 to £4,008. There was a balance to be dealt with of £42,238, against £24,200 last year. It would be seen that they were putting away considerably more than they were distributing in dividend, and they felt that such a prudent and wise course would materially strengthen the company. There were two reasons for putting away so large a sum. One was with regard to the resolution which would be proposed for the increase of capital to deal with the growing business. They wished to do this without diminishing the ordinary dividend. The second reason was that sooner or later the power house of the Municipal Tramways Trust would be completed. It had been anticipated that the power house would have been completed by now, but up to the present the company had supplied the energy required. He did not know how long that was going on, but probably in the course of the current financial year the load would be transferred and the company would lose that portion of its revenue. On the other hand, the growth of their suburban business was so rapid that it seemed likely they would not be very long in making up a considerable portion of the loss of their new connections. As they knew, under their terms with the City of Adelaide, the local authority had power to acquire the undertaking on December 11th, 1911, and they had received a letter from the town clerk making some preliminary inquiries on the subject. If the undertaking was so purchased it had to be done by agreement, and therefore it was not a matter which need cause them any anxiety.

MR. GEO. BROOKMAN (chairman of the local board), in seconding the motion, congratulated the shareholders on the very satisfactory business which had been done, and said the company had still a large amount of work to do in the suburbs. They had done a large amount of work there already, from which they had not yet received the benefit which they would get as the years went on. They had wired a large number of streets, and consumers were gradually coming in. He had received a letter from one of the local directors stating that there were 500 consumers waiting to be connected, mainly in the suburbs. He thought the outlook for the company was particularly good.

MR. C. G. WILSON said that he lived in New South Wales, and he had to pay no fewer than three income-taxes. He considered this a great hardship on the Australian shareholder.

The CHAIRMAN said the directors had had this matter before them, and a deputation from different companies interested in Colonial enterprise had waited on the Chancellor of the Exchequer. Personally, he thought their company was different from some of the other companies, and if the Chancellor of the Exchequer came back to power he proposed again waiting on him.

The report was adopted.

The CHAIRMAN then proposed a resolution to increase the capital of the company by the issue of 20,000 ordinary shares of £5 each. He said it was not a large sum to issue, but considering the uncertainty as to the length of time the company might go on, they thought it not wise to issue too much. This would enable them to go on for a year or two.

MR. WILSON seconded the motion.

A SHAREHOLDER urged that there should be no underwriting of the new capital, but that it should be offered to the present shareholders.

The CHAIRMAN said they would take that into consideration, and up to the present they had not been very great sinners in regard to underwriting. Whatever was done would be for the benefit of the company.

The motion was carried.

The CHAIRMAN next moved a resolution to the effect the board be authorised to take 5 per cent. of the amounts set aside for the equalisation of dividend as further remuneration. He explained that the directors were entitled to the money under the articles if the whole of the profits were divided, and he took it that the shareholders did not wish the board to be penalised as the result of their prudence.

Several shareholders asked for further information regarding the proposal, and

MR. H. F. FARISH pointed out that it did not mean that the board took 5 per cent. of the whole profit, but only on the sum set apart for the payment of the ordinary dividend. The fixed remuneration of the directors was only nominal. In the present balance-sheet the directors' remuneration was £690, and of this £300 was fixed, and £390 represented the 5 per cent. on the balance for the year before last.

The resolution was carried, and the retiring director and auditors were re-elected.

Replying to a further question, the CHAIRMAN said that for September the profit of the company showed an increase of £320, but of course that was only for one month.

Castner-Kellner Alkali Co., Ltd.—This company held its meeting at Cannon Street Hotel, E.C., on November 24th, the Right Hon. G. W. Balfour presiding. In moving the adoption of the report, the chairman congratulated shareholders upon the continued and increasing prosperity of the company. The net profit, after allowing for the amount expended in keeping up the works, plant and machinery, was £164,554, an increase of £30,000. The total distribution by way of dividend was 17½ per cent., an increase of 3½ per cent., and £15,158 was carried forward. After alluding to the misapprehension of some shareholders as to the nature of the depreciation reserve, and to the progress of the company, the chairman said that their relations with their workpeople both at Newcastle and Runcorn were uniformly friendly, this being in some degree attributable to the bonus system introduced two or three years ago, which was working very well. So far as he could see there was no reason to think that they would not do equally as well in the future as they had done in the past. Trade was good; it had been improving during the past six months, and was likely to continue good, at all events for the next 12 months.

Electrical Securities Trust, Ltd.

The report, as appearing in the *Financier*, states that the results for the year to November 14th, after charging all expenses and the interest due and accrued on the debentures, show a loss of £4,706. This does not include the book loss on the South-Western Traction Co. bonds, held by the Trust, which amounts to £24,307, and this has been shown separately in the balance-sheet. In view of the disappointing position of the securities held by the Trust, and the fact that the income received was insufficient to meet the interest due upon the debentures, the directors felt that it was necessary that an arrangement should be made with the debenture-holders, and the expense of nursing and realising the remaining securities reduced to the utmost extent. After communication with various holders of a large amount of the debentures, it was proposed that the trustees should distribute the proceeds of the bonds of the South-Western Traction Co. of Canada, and realise and distribute the balance of the trust funds in terms of the agreement and deed of trust. It was further proposed that the trustees should have power to borrow money on the security of the trust funds, and to apply any of the funds in their hands for the purposes of improving, maintaining and developing any of the remaining unrealised securities, and that the directors should act as trustees for the debenture-holders, and also as directors of the company, without any remuneration, unless such as might be voted to them by the debenture-holders after it was seen how the realisation of the remaining securities resulted. The Alliance Trust Co. trustees for the debenture-holders, having given notice of their intention to resign, a meeting of the debenture-holders was called in terms of the trust deed, and resolutions giving effect to the proposed arrangement were submitted to that meeting and duly passed by the requisite majority of the debenture-holders present and represented at the meeting. A supplemental agreement embodying the said resolutions was thereafter entered into between the trust and the new trustees. Thereafter the trustees for the debenture-holders, out of the amount received from the liquidator of the South-Western Traction Co. of Canada, made a distribution of £50,000 *pro rata* among the debenture-holders.

Isle of Thanet Electric Tramways and Lighting Co., Ltd.

Lord Arthur Butler presided at Winchester House, E.C., on December 1st, over the ordinary general meeting of this company. In moving the adoption of the report, he said that the statement for the year ended September 30th was the most satisfactory that had yet been placed before them. Since they met there a year ago the position of the company had improved in every respect, and they believed that the improvement would continue. The passenger receipts showed the substantial increase of £2,550. The receipts from the sale of current increased by £873, which was a gratifying result having regard to the fact that the introduction of the metallic-filament lamp had checked the growth of consumption of current in the case of a good many electric light companies. The total receipts showed the gratifying increase of £3,624 on the year. They would find in the details of the expenditure account equal cause for gratification. Every item under the head of general expenses was lower than that of the previous year, with the single exception of rates and taxes, which were £258 higher. Notwithstanding this increase, the total of general expenses was down by £313, and if the rates and taxes had not increased, the general expenses would have been £571 less than last year. Seeing that the general expenses included all the costs of handling the increased passenger traffic, they might fairly acknowledge the care with which the manager had controlled the expenses. The working of the power station showed a still more satisfactory result, for although the current generated had increased to 136,471 units, the total cost of production, including the increased output, had been actually £1,008 less than in the previous year. There was a saving of £911 on the item coal and coke, due, partly, to the lower price paid for fuel, partly to the use of a larger proportion of coke, and partly to the greater efficiency with which the station was worked since the additional generating plant was installed last year. When he came to the item of maintenance, he had not the same satisfactory tale to tell, as there was an increase under this head of £1,336. The most serious expenditure that tramway undertakings were confronted with after they had passed a certain number of years was that of maintenance and renewals. They would recollect that last year they set aside £1,500 against further maintenance, and they would have been justified in applying some of this money towards reducing the charge this year, but having effected such a substantial saving under other heads of expenditure, they thought it more conducive to the permanent interests of the company not to withdraw anything of the reserve fund which they put aside last year. On the contrary, they decided that this reserve fund should be increased out of the profits of the year by £2,500, bringing it up to £4,000. There was an item of law costs amounting to £217 which he would like to explain. Their manager, Mr. Ford, was made the subject of a series of charges amounting to fraud upon the company, which, had there been any foundation for them, would have rendered him quite unfit to retain his position. The directors never for a moment believed those charges to be true, but they thought that in the interests of the company, as well as in his own interests, Mr. Ford should take action against the libeller. The case came before the High Courts of Justice last February, and it resulted in the most complete vindication of Mr. Ford that anyone could require, with a verdict of £400 damages and costs. The libeller, however, proved to be on safe ground, for he filed his petition in bankruptcy before the judgment was issued, and Mr. Ford got neither damages nor costs paid to him. The directors felt bound under these circumstances to indemnify Mr. Ford against his loss, and they accordingly paid his costs, which course, he had no doubt, would have the cordial approval of the shareholders. The result of the operations of the combined tramways and light business for the year, was that they had earned a profit of £18,242, against £15,032 in the previous year, and as against £13,390 the year before, so that in three years the profits had increased by £4,852, or very nearly 38 per cent. The capital expenditure during the year was £2,204, of which £2,026 was for extension of lighting mains, and for connecting consumers, which resulted in an increase in the lighting revenue of £873 for the year. They would notice a new item: "Contractor's unpaid balance of £1,750." That was the unpaid balance of the sum of £3,750 which the company received in cash from the Thanet Construction Co. in consideration of releasing them from the liability to complete the extension of the tramways at the south-eastern terminus at Ramsgate. Mr. Murphy entered into a contract to carry out the work for the same sum, and it was duly completed, but he was only paid £2,000, the balance of £1,750 remaining due to him. As a matter of fact, the company had had the use of the money for the last six or seven years, free of interest, which Mr. Murphy had not claimed hitherto, and he was still willing to allow it to stand over until they were in a position to discharge it. After providing for debenture interest and other charges, they had £11,027 for division. Out of this the directors proposed to pay a dividend of 2½ per cent. on the preference shares; they further recommended that £2,500 be added to the general reserve fund, bringing that up to £11,000; that £2,500 be appropriated for the further maintenance, to which he had already referred, and that the balance of £2,767 be carried forward. The directors felt sure that the shareholders would approve of this conservative policy in dealing with the profit as it was already reflected in the improved position of the company's credit, and in the enhanced value of the preference shares. The directors believed that the financial arrangements they made to tide the company over a period of temporary depression, were the very best under the circumstances, and they were certainly justified by the results. They were able to borrow from their bankers at a much lower rate of interest than would have been entailed by the issuing of debentures at a discount, or by the creation of a prior lien charge, such as was urged by some of their shareholders. During the year, £3,000 was paid off the bankers' loan, and the cash balance was £1,582 better than the year before. Altogether he thought they might congratulate the shareholders on the improved position of the company's affairs, and they ventured to hope that in the current year the results would show a still further improvement.

Mr. H. Brown seconded the motion.

Mr. Lea Smith pointed out that the auditors said there was no allowance for depreciation.

The Chairman said that was so, but they had added to the reserve for permanent way, which was the same thing as providing for depreciation.

Mr. Holman asked if the company had to pay income-tax on the sum put to reserve.

The Secretary said the surveyor took the accounts, and allowed depreciation on machinery and plant of 4 per cent. all round, and then aggregated three years, and they paid income-tax on the average of the three years' profit.

The accounts were then adopted, and the retiring director and auditors re-elected.

Blackpool, St. Anne's and Lytham Tramways Co., Ltd.

The annual meeting, held on December 5th, considered the annual report of the directors, which stated that the trustees for the debenture-holders had intimated their intention of paying 2½ per cent. interest on account of the arrears. Last year interest at the rate of 3 per cent. was paid. The balance-sheet showed the interest accrued to date on the debenture stock to be £29,375, compared with £26,375 a year ago. The sinking fund had been increased from £7,500 to £9,000, and the advance account of the bank—secured by a deposit of £15,000 prior debentures—had been reduced from £9,000 to £7,500. The amount owing for electricity, rates, taxes, &c., was now £2,899. The cost of the company's property was shown at £284,752, against £281,727 twelve months ago, the increase being accounted for by the extension of the car depôt at Squires Gate Stores. The stock of rails, &c., on hand, were valued at £5,397 (last year £4,456); debts due to the company figure at £798 (£1,451); rates, taxes, &c., £579 (£575); cash in hand, £10,146 (£13,608); and balance of profit and loss account, £22,109 (£18,932). The revenue account showed that traffic expenses absorbed £4,876 (£4,574 last year); general expenses, £3,380 (£3,324); repairs and maintenance, £4,277 (£3,529); power, £4,917 (£4,830); and leased lines, £2,396 (£2,406). The net traffic receipts, after payment of £5,517 to Blackpool Corporation for traffic over the Blackpool lines, were £24,963 (£24,677); and the amount for advertising, &c., was £708 (£628), giving a total revenue of £25,305; £5,823 is carried to the profit and loss account as compared with £6,640 in the previous year.

As a result of the payment of bonuses to car drivers, there was a gratifying decrease in the consumption of electricity per car-mile; in fact, no other company could show a smaller consumption. It was further pointed out that important developments were contemplated, including the erection of a new car depôt and new offices.

MARKET QUOTATIONS.

Wednesday, December 7th.

CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	..
a " Nitric	"	22/-	..
a " Oxalic	"	28/-	..
a " Sulphuric	"	5/6	..
a Ammoniac, Sal	"	42/-	..
a Ammonia, Muriate (crystal)	per ton	£29	..
a " "	"	£30	..
a Bleaching powder	"	£5 10	..
a Bisulphide of Carbon	"	£18	..
a Borax	"	£16	..
a Ferro-Silicon (50 %)	"	£9 10	..
a Copper Sulphate	"	£18	..
a Lead, Nitrate	"	£25	..
a " White Sugar	"	£22 15	15/- dec.
a " Peroxide	"	£32	..
a Methylated Spirit	per gal.	2/6	..
a Potassium, Bichromate, in casks	per lb.	8½d.	..
a Potash, Caustic (75/80 %)	per ton	£20	..
a " Chlorate	per lb.	3½d.	..
a " Perchlorate	"	4½d.	..
a Potassium, Cyanide	"	7d.	..
a Shellac	per cwt.	85/-	..
a Sulphate of Magnesia	per ton	£4 10	..
a Sulphur, Sublimed Flowers	"	£6 10	..
a " Recovered	"	£5 10	..
a " Lump	"	£5	..
a Soda, Caustic (white 70 %)	"	£11	..
a " Chlorate	per lb.	3½d.	..
a " Crystals	per ton	£3 5	..
a Sodium Bichromate, casks	per lb.	3d.	..
a " Cyanide (basis 100 %)	"	7d.	..
METALS, &c.			
b Aluminium Ingots, in ton lots	per ton	£80	..
b " Wire, in ton lots	"	£112	..
b " Sheet, in ton lots	"	£120	..
p Babbitt's metal ingots	"	£38 to £145	..
c Brass (rolled metal 2" to 12" basis)	per lb.	6½d.	..
c " Tube (brazed)	"	8½d.	..
c " " (solid drawn)	"	7d.	..
c " Wire, basis	"	6½d.	..
c Copper Tubes (brazed)	"	9d.	..
c " " (solid drawn	"	8⅜d.	..
g " Bars (best selected)	per ton	£73	..
g " Sheet	"	£73	..
g " Rod	"	£73	..
e " (Electrolytic) Bars	"	£60	..
e " " Sheets	"	£76	..
e " " Rod	"	£63 15	..
e " " H.C. Wire	per lb.	8d.	..
f Ebonite Rod	"	6/-	..
f " Sheet	"	5/6	..
n German Silver Wire	"	1/11	..
h Gutta-percha, fine	"	..	..
h India-rubber, Para fine	"	6/1½	1½d. dec.
l Iron Pig (Cleveland warrants)	per ton	49/7	2d. inc.
l " Wire, galv. No. 8, P.O. qual.	"	£14	..
g Lead, English Ingot	"	£13 7 6 to £13 12 6	..
m Manganin Wire No. 28	per lb.	6/6	..
g Mercury	per bot.	£8	..
d Mica (in original cases) small	per lb.	6d. to 1s.	..
d " " " medium	"	2/6 to 4/-	..
d " " " large	"	4/6 to 8/6	..
p Phosphor Bronze, plain castings	"	11d.	..
p " " rolled bars & rods	"	1/0½	..
p " " rolled strip & sheet	"	1/1	..
o Platinum	per oz.	160/-	..
e Silicium Bronze Wire	per lb.	9d.	..
r Steel Magnet, in bars	per ton	£55	..
g Tin, Block (English)	"	£167 to £168	..
n " Wire, Nos. 1 to 16	per lb.	1/11	½d. inc.
p White Anti-friction Metals	per ton	£45 to £150	..
k Zinc, Sh's (Vieille Montagne bnd.)	"	£29 15	..

Quotations supplied by—

a G. Boor & Co.
b The British Aluminium Co., Ltd.
c Thos. Bolton & Sons, Ltd.
d F. Wiggins & Sons.
e Frederick Smith & Co.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakspeare.
h Edward Till & Co.
l Bolling & Lowe.
k Morris Ashby, Ltd.
l Richard Johnson & Nephew, Ltd.
m W. T. Glover & Co., Ltd.
n P. Ormiston & Sons.
o Johnson, Matthey & Co., Ltd.
p
r W. F. Dennis & Co.

Official Announcements re Companies.—The following companies will, unless cause is shown to the contrary, be struck off the register, and will accordingly be dissolved :—

All-British Card Systems Co., Ltd.
Anglo-American Aluminium Co., Ltd.
British Electric Equipment Co., Ltd.
Gas Traction Co., Ltd.
Sir Hiram Maxim Electrical and Engineering Co., Ltd.
Telescriptor Syndicate, Ltd.

Blackpool Time.—Mr. Furness, the borough electrical engineer and tramways manager, has submitted a scheme to the Council for the installation of a system of synchronised clock dials in different parts of the town to regulate the tram time service. Mr. Furness estimated that for a minimum of 25 dials the first cost would be £250, and for a minimum of 50 dials, £450. The Council, though favourable to the idea, have referred the proposal back for information as to the cost of a smaller installation.

STOCKS AND SHARES.

Tuesday Evening.

FINANCE takes a back-seat in the commercial world while the political excitement is running high, and movements in prices are of secondary consequence to those in the majority of parties. The Stock Exchange, of course, takes the keenest interest in the struggle, because, apart from other things, it is generally recognised that a Unionist victory—or a pronounced reduction in the Coalition majority—would help business and prices to a marked extent. Accordingly, the first results were awaited with something like anxiety, and received with much disappointment, the Stock Exchange having looked for considerably better declarations than those which were made.

Consols fell sharply, after having been put up substantially during the latter part of last week. Home Rails had enjoyed a further access of strength, in which Metropolitan Consolidated and District Ordinary both participated, but the movement received an abrupt check. The buying of the Undergrounds is fairly consistent, and profit-taking sales, by those people who were lucky enough to get in earlier, were absorbed with ease, but the political disappointment caused depression all round. The Central London trio, with City and South London Ordinary stock, are still quiescent. The contention advanced here last week that the issues are all likely to come shortly into popular notice is endorsed by men in the market, although no practical effect is given to it at present.

The lowering of the Bank Rate from 5 per cent. to 4½ per cent. last Thursday is a lever that will act powerfully upon investment markets when the political and holiday influences grow less. Disappointment is expressed at the comparatively slight rises which followed upon the actual announcement, but there are so many other things to think about just now that the irresponsiveness of quotations need be no subject for wonder, and the holder of good class investments can console himself with the reflection that another reduction in the Rate is rendered so much the nearer by reason of the quite unexpected fall last Thursday.

Electricity supply shares are in their usual quiet state, in sharp contrast to the activity of the Electricity Publicity Committee, which is making itself felt in a number of different channels. The work was accorded financial recognition the other day by the joint conference of London Electric Supply Authorities, when a substantial sum was voted to the funds of the Publicity Committee for the purpose of developing a still more vigorous advertising programme. While it can hardly be expected that the share-market will benefit from these proceedings in the immediate future, ultimately, of course, they are bound to tell, and it is an excellent policy to concentrate energy on the commercial side of the business without wasting money on the attempt to rehabilitate the prices of stocks and shares, which will reap the advantage all the more materially later on.

Domestic politics in Mexico and Brazil are understood to have settled down to a peaceful basis again, and the prices of electrical issues of companies in those Republics are no longer disturbed by rumours of revolution. Nevertheless, the quotations continue a little dull. Rio Trams are 105¼ and the Bonds 100¼. Monterey Debenture has picked up ½, and is now 92. Mexican Light and Power descriptions are still weak, but the Tramways retain their advance. A steady demand for Anglo-Argentine Trams put the top price $\frac{1}{16}$ over par, which is the first time they have reached it since the reorganisation of the company's capital account. Para Electric Railways and Lighting 5 per cent. Debenture stock was quoted *ex* dividend last week, and a quiet business is being done in it at about 98¼, the Ordinary and Preference shares being 7¼ and 5⅜ respectively.

Cape Electric Trams continue to creep up ; the middle price at 10s. shows another $\frac{1}{16}$ rise. British Electric Traction Preference fell ¼, while the Second Debenture stock added one to its gain of two points a week ago. A few bargains have been recorded in Potteries Traction Ordinary, and the Preference are indicated in some quarters as a good investment at the current quotation of about 12s. We should say that money would be better employed elsewhere.

West India and Panama Ordinary, First Preference and Second are *ex* their dividends of 1s., 6s. and 15s. respectively, the prices practically reflecting these deductions. Anglo-American Telegraph Preferred rose sharply on the improvement which occurred amongst investment stocks generally as a result of the fall in the Bank Rate. The Eastern group keeps very firm. American Telephone and Telegraph has been marked down 1. There is no change in the Trust companies' issues.

Fluctuations amongst Telephone stocks and shares are insignificant, and the manufacturing division keeps quietly firm on the whole. Willans & Robinson Debenture stock has reacted.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share.	Dividends for the last four years.				Closing Quotations Nov. 29th.	Closing Quotations Dec. 6th.	Business done week ended Dec. 6th, 1910.		Rise + or Fall —	Present Yield per cent.
		*	1906.	1907.	1908.	1909.			Highest	Lowest.		£ s. d.
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	Nil	Nil	Nil	Nil	5⅛ — 6	5⅛ — 6	..	..	..	Nil.
286,500	Do. 5 % Deb. Red. Iss. at 98 % script all paid	Stock	5 %	5 %	5 %	5 %	96 — 98	96 — 98	..	..	..	5 2 0
$255,196,000	American Telephone & Telegraph, Cap Stock ..	$100	8 %	8 %	8 %	8 %	144 —147	143 —146	..	..	—1	5 9 7
$53,000,000	Do. Collat. Trust, 4% Bonds, 1 to 28,000 and 53,001 to 78,000	$1000	4 %	4 %	4 %	4 %	94⅛ — 96⅛	94⅛ — 96⅛	..	..	..	4 2 11
558,460	Anglo-American Telegraph	Stock	3⅞%	3⅛%	£3 4s.	3⅛%	65⅛ — 67⅛	68 — 70	..	..	+2½	5 3 7
3,220,770	Do. do. do. 6 % Pref.	Stock	6 %	6 %	6 %	6 %	106 —108	110 —112	111	107½	+4	5 7 2
3,220,770	Do. do. do. Deferred	Stock	1¾%	1 %	8/-	25/-	26⅝ — 27	27⅞ — 28⅛	28 5/16	26 15/16	+1½	4 8 6
47,725	Anglo-Portuguese Tel., 5 % Mort. Deb. Stock Red.	100	5 %	5 %	5 %	5 %	102 —104	102 —104	..	..	..	4 16 2
44,000	Chili Telephone, Nos. 1 to 44,000	5	8 %	8 %	8 %	8 %	7 — 7⅛	7 — 7⅛	7 3/16	..	..	5 10 4
2,449,176	Commercial Cable, Stlng. 500 year 4% Deb. Sk. Red.	Stock	4 %	4 %	4 %	4 %	85 — 87	85 — 87	86⅜	86	..	4 12 0
16,000	Cuba Telegraph	10	5 %	6 %	6 %	6 %	8⅛ — 9⅛	8¼ — 9¼	..	..	..	6 9 9
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	10 %	16⅜ — 17⅜	16⅜ — 17⅜	..	..	..	5 15 11
12,981	Direct Spanish Telegraph, Ord.	5	4 %	4 %	4 %	4 %	3⅜ — 3⅝	3⅜ — 3⅝	..	..	..	5 1 7
6,000	Do. do. 10 % Cum. Pref. ..	5	10 %	10 %	10 %	10 %	8½ — 8⅝	8¼ — 8⅝	..	..	..	5 14 3
30,000	Do. do. 4½ % Debs.	50	4½%	4½%	4½%	4½%	101 —103	101 —103	..	..	..	4 7 5
60,710‡	Direct United States Cable	20	4⅜%	4½%	4½%	4 %	14½ — 15⅜	15⅜ — 16¼	16⅛	15⅞	+ ⅛	4 18 6
	Direct W. India Cable, 4½% Reg. Deb., 1 to 1,200, R.	100	4½%	4½%	4½%	4½%	100¾ —102½	100¾ —102½	..	..	..	4 7 10
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	7 %	135 —138	135 —138	136½	135½	..	5 1 5
2,000,000	Do. 3½ % Pref. Stock	100	3½%	3½%	3½%	3½%	83 — 85	83 — 85	84¼	84⅛	..	4 2 4
1,896,706	Do. 4 % Mort. Deb. Stock Red. ..	Stock	4 %	4 %	4 %	4 %	99½ —101½	99¼ —101½	99⅝	..	..	4 18 10
800,000	Eastern Extension, Australasia, and China Tele.	10	7 %	7 %	7 %	7 %	12¼ — 13	12⅝ — 13⅛	12¼	..	+ ⅛	5 6 8
752,400	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	100 —102	100 —102	..	..	..	3 18 5
200,000‡	East. & S. Afric. Tel., 4 % Mt. Db. Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4 %	4 %	99 —101	99 —101	..	..	..	3 19 3
181,127	Globe Telegraph and Trust	10	5⅜%	5⅜%	5⅜%	5⅜%	10⅛ — 10⅜	10⅛ — 10⅜	10⅜	10⅞	..	5 9 5
181,127	Do. do. 6 % Pref.	10	6 %	6 %	6 %	6 %	13⅛ — 13⅜	13⅛ — 13⅜	13⅜	..	..	4 7 3
150,000	Great Northern Telegraph, of Copenhagen..	10	20 %	20 %	18 %	18 %	30½ — 31¾	30½ — 31¾	..	..	..	5 14 9
17,000	Indo-European Telegraph	25	13 %	13 %	13 %	13 %	53 — 55	53 — 55	..	..	..	5 18 7
$41,380,400	Mackay Companies Common	$100	3½%	4 %	4 %	4½%	95 — 98	95 — 98	..	..	..	4 6 9
$50,000,000	Do. do. 4% Cum. Pref.	$100	4 %	4 %	4 %	4 %	75 — 80	75 — 80	..	..	..	5 0 0
394,190	Marconi's Wireless Telegraph	1	Nil	Nil	Nil	Nil	3/16 — ¼	3/16 — ¼	15/9	..	..	Nil
72,680	Monte Video Telephone Co., Ltd. Ord.	1	6 %	6 %	6 %	6 %	¾ — 1	¾ — 1	..	..	..	6 0 0
86,492	Do. do. do. 5 % Pref. ..	1	5 %	5 %	5 %	5 %	13/16 — 15/16	13/16 — 15/16	16/3	..	..	5 8 4
2,225,000	National Telephone, Pref. Stock	100	6 %	6 %	6 %	6 %	105¼ —106½	105½ —106½	106	105⅜	+ ½	5 12 5
3,725,000	Do. do. Def. Stock	100	5 %	6 %	6 %	6 %	128 —130	128 —130	129½	128½	..	4 12 4
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	6 %	10⅛ — 10⅞	10⅛ — 10⅞	10⅜	..	..	5 10 4
15,000	Do. do. 6 % Cum. 2nd Pref.	10	5 %	6 %	6 %	6 %	10¼ — 10⅞	10¼ — 10⅞	..	..	..	5 10 4
250,000	Do. do. 5 % Non-cum. 3rd P., 1 to 250,000	5	5 %	5 %	5 %	5 %	5 1/16 — 5 1/8	5 1/16 — 5 1/8	..	..	..	4 10 0
2,000,000	Do. do. 3½ % Deb. Stock Red. ..	Stock	3½%	3½%	3½%	3½%	99 —101	99 —101	..	..	..	3 9 4
1,983,593	Do. do. 4 % Deb. Stock Red... ..	100	4 %	4 %	4 %	4 %	99 —101	99 —101	..	..	..	3 19 3
179,313	Oriental Telep. and Elec. 1 to 171,504, fully paid..	1	7 %	8 %	8 %	8 %	1 3/16 — 1 1/4	1 3/16 — 1 1/4	..	..	..	4 14 10
50,000	Do. do. 6 % Cum. Pref.	1	6 %	6 %	6 %	6 %	1 3/16 — 1 5/16	1 3/16 — 1 5/16	31/3	..	..	4 7 3
195,955	Do. do. do. 4 % Red. Deb. Stock..	100	4 %	4 %	4 %	4 %	88 — 90	88 — 90	..	..	..	4 8 11
99,400	Pacific & European Tel., 4 % Guar. Debs., 1 to 1,000	100	4 %	4 %	4 %	4 %	99 —101	99 —101	..	..	..	3 19 7
11,889	Reuter's	8	5 %	5 %	5 %	5 %	7½ — 8	7½ — 8	..	..	..	5 0 0
145,955	Telephone Co. of Egypt, 4½ % Deb. Red.	100	4½%	4½%	4½%	4½%	98 —100	98 —100	..	..	..	4 9 7
3,042	Submarine Cables Trust.	Cert.	6 %	6 %	6 %	6 %	131 —134	131 —134	..	..	..	4 9 7
120,000	United River Plate Telephone	5	8 %	8 %	8 %	8 %	7 3/16 — 7 7/16	7¼ — 7⅜	7⅜	7⅜	+ 1/16	5 6 8
40,000	Do. 5 % Cum. Pref., Nos. 1 to 40,000	5	5 %	5 %	5 %	5 %	5 5/16 — 5 3/8	5⅜ — 5⅝	5⅝	..	— 1/16	4 8 11
30,008	W. Coast of America, 1 to 80,000 & 53,001 to 53,008	2½	2½%	2½%	2½%	2½%	1 5/16 — 1 7/16	1 5/16 — 1 5/8	..	..	..	4 12 8
150,000	Do. 4 % Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	4 %	4 %	4 %	4 %	99 —101	99 —101	..	..	..	3 19 3
207,930	Western Telegraph, Ltd., Nos. 1 to 207,930 ..	10	7 %	7 %	7 %	7 %	13⅜ — 13⅞	13⅜ — 14⅛	13⅞	13½	+ ½	4 17 5
800,000	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	4 %	101—103	101 —103	101¼	..	..	3 17 8
88,321	West India and Panama Telegraph	10	Nil	Nil	Nil	Nil	1 5/16 — 1 7/16	1 3/8 — 1 13/16 xd	27/6	26/9	..	Nil
84,563	Do. do. 6 % Cum. 1st Pref.	10	8 %	6 %	6 %	6 %	9 5/16 — 10¼	9⅜ — 9¼ xd	9⅜	9⅜	..	6 4 8
4,609	Do. do. 6 % Cum. 2nd Pref.	10	Nil	£2 6	15 %	14½%	9½ — 10	8¼ — 9¼	..	..	— ¾	6 9 9
80,000‡	Do. do. 5 % Debs., Nos. 1 to 1,800 ..	100	5 %	5 %	5 %	5 %	102 —104	102 —104	..	..	..	4 16 2

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

640,000	Anglo-Argentine Trams, 5% Cum. 1st Pref. 1 to 640,000	5	..	..	..	5 %	4⅜ — 5	4⅞ — 5⅛	101/10⅛	97/6	+ ⅛	4 17 7
500,000	Do. 5 % 2nd Pref., 800,000 to 1,300,000	5	..	..	..	5 %	4¼ — 4⅜	4¼ — 4⅜	88/9	..	..	5 5 3
4,465,674	Do. 4 % Deb. Stock	Stock	..	..	4 %	4 %	92 — 93⅜	92 — 93⅜	93⅛	92½	..	4 5 7
932,887	Auckland E. Trams, 5 % 1st Mort Deb. Stock ..	100	5 %	5 %	5 %	5 %	103 —105	103 —105	..	..	..	4 15 3
930,000	Babcock & Wilcox, 1 to 930,000	1	20 %	20 %	20 %	24 %	5⅝ — 5¾	5⅝ — 5¾	5 11/16	..	..	4 2 7
100,000	Do. do. 6 % Cum. Pref., 1 to 100,000 ..	1	6 %	6 %	6 %	6 %	1⅜ — 1½	1⅜ — 1½	..	..	..	4 0 0
1,000,000	British Aluminium 5 % Mort. Debs. Red.	100	..	..	..	..	..	..	..	..	..	5 9 7
500,000	British Columbia E. Rail Def. Ord. Stock	100	6 %	8 %	8 %	8 %	146 —150	146 —150	..	..	..	5 6 8
400,000	Do. Pref. Ord. Stock	100	5 %	5 %	6 %	6 %	123 —127	123 —127	..	..	..	4 14 6
400,000	Do. 5 % Cum. Perp. Pref. Stock	100	5 %	5 %	5 %	5 %	110 —113	110 —113	112	..	..	4 8 6
233,000	Do. 4½ % 1st Mort. Deb., 1 to 6,250	40	4½%	4½%	4½%	4½%	100 —102	100 —102	..	..	..	4 8 3
212,600	Do. 4½ % Vancouver Power Debs., 1 to 2,200	100	4½%	4½%	4½%	4½%	100 —103	100 —103	..	..	..	4 7 5
133,301	British Electric Traction	10	Nil	Nil	Nil	Nil	¾ — 1	13/16 — 1 1/16	18/3	16/3	+ 1/16	Nil
161,437	Do. do. 6 % Cum. Pref.	10	6 %	3 %	1½%	Nil	3⅜ — 4½	3⅞ — 3⅞	7⅝/7¼	72/6	..	Nil
1,473,653	Do. do. 5 % Perp. Deb. Stock ..	Stock	5 %	5 %	5 %	5 %	89 — 93	89 — 93	91½	..	..	5 7 6
528,936	Do. do. 4½ % 2nd Deb. Stock Red.	100	4½%	4½%	4½%	4½%	74 — 79	75 — 80	..	..	+1	5 12 6
100,000	British Insulated and Helsby Cables	5	10 %	10 %	10 %	10 %	6¾ — 7¼	6¾ — 7¼	..	..	..	6 17 11
100,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	6 %	5⅝ — 6	5⅝ — 6	..	..	..	5 0 0
500,000	Do. do. 4½ % 1st Mort. Deb. Red...	100	4½%	4½%	4½%	4½%	101 —104	101 —104	..	..	..	4 6 7
201,579‡	British Thomson-Houston 4½ % 1st Mort. Debs. ..	100	4½%	4½%	4½%	4½%	98 —101	98 —101	..	..	..	4 9 1
400,000	British Westinghouse 6 % Pref., 1 to 200,000 and 275,001 to 75,000	5	Nil	Nil	Nil	Nil	5/16 — 9/16	5/16 — 9/16	9/4½	6/6	..	Nil
1,316,353	Do. do. 4 % Mort. Deb. Stock ..	100	4 %	4 %	4 %	4 %	59 — 62	59 — 62	..	..	..	6 9 1
50,000	Browett, Lindley & Co., Ord.	1	Nil	Nil	Nil	Nil	1/16 — 1/8	1/16 — 1/8	..	..	..	Nil
50,000	Do. do. 6 % Cum. Pref.	1	Nil	Nil	Nil	Nil	14/6 to 15/6	14/6 to 15/6	..	..	..	Nil
140,976	Brush Electrical Engineering, Ord., 1 to 105,731 ..	2	Nil	Nil	Nil	Nil	0 — ⅛	0 — ⅛	..	..	..	Nil
200,000	Do. do. Non-cum. 6 % Pref... ..	2	Nil	Nil	Nil	Nil	0 — ⅛	0 — ⅛	..	..	..	Nil
125,000‡	Do. do. 4½ % Perp. Deb. Stock ..	Stock	4½%	4½%	4½%	4½%	37 — 42	37 — 42	39½	..	..	10 14 4
125,000‡	Do. do. 4½ % Perp. 2nd Deb. Stock..	Stock	4½%	4½%	4½%	4½%	23 — 27	23 — 27	25	..	..	18 19 3
137,610	Calcutta Trams, 1 to 137,610	5	8 %	6 %	4½%	4½%	4½ — 5	4½ — 5	99/9	..	..	4 10 0
45,304	Do. 5 % Cum. Pref., Nos. 1 to 29,330..	5	5 %	5 %	5 %	5 %	4⅝ — 5⅛	4⅝ — 5⅛	..	..	..	4 17 7
350,000	Do. 4½ % 1st Deb. Stock	100	4½%	4½%	4½%	4½%	98 —101	98 —101	99	..	..	4 9 1
35,000	Callender's Cable Construction shares	5	15 %	15 %	15 %	10 %	9⅛ — 9⅜	9⅛ — 9⅜	9⅛	..	..	5 3 3
40,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	4 15/16 — 5 1/16	4 15/16 — 5 1/16	5⅛	..	..	4 5 9
300,000	Do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	104 —106	104 —106	..	..	..	4 4 11
491,222	Cape E. Trams., 1 to 491,222	1	Nil	Nil	Nil	Nil	3/16 — 5/16	3/16 — 5/16	11/6	10/-	..	Nil
450,000	Castner-Kellner Alkali, 1 to 450,000	1	8 %	12 %	12½%	17½%	3 3/16 — 3 5/16	3 1/16 — 3 5/16 xd	61/6	61/3	..	5 6 3
210,153	Do. do. 4½ % 1st Mort. Deb. Stock	100	4½%	4½%	4 %	4½%	105 —108	105 —108	..	..	..	4 3 4
1,890,690	Central London Railway, Ord. Stock	Stock	4 %	3 %	3½%	3 %	64 — 65	63 — 65	65	64½	..	4 12 4
554,655	Do. do. 4 % Pref. Stock	Stock	4 %	4 %	4 %	4 %	85 — 87	85 — 87	..	..	..	4 12 0
554,655	Do. do. Def. do.	Stock	4 %	2 %	2½%	2 %	44 — 46	44 — 46	..	..	..	4 7 0
1,480,000	City and South London Railway	Stock	2½%	2½%	1½%	1⅜%	26½ — 27½	26⅝ — 27½	27⅜	26½	..	6 7 3
85,000	Crompton & Co., Nos. 1 to 85,000	8	5 %	5 %	Nil	Nil	¼ — ⅜	¼ — ⅜	..	..	..	Nil
100,000‡	Do. 5 % 1st Mort. Reg. Debs., 900 of £100, and 901 11,000 of £50 Red	..	5 %	5 %	5 %	5 %	83 — 86	83 — 86	..	..	..	5 17 8

* Unless otherwise stated, all shares are fully paid. ‡ From Manchester Share List.

Continued on next page.

SHARE LIST OF ELECTRICAL COMPANIES.—(*Continued.*)

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.—(*Continued.*)

Present Issue.	NAME.	Stock or Share.	Dividends for the last four years.				Closing Quotations Nov. 29th.	Closing Quotations Dec. 6th.	Business done week ended Dec. 6th, 1910.		Rise + or Fall —	Present Yield per cent.
		*	1906.	1907.	1908.	1909.			Highest	Lowest		£ s. d.
260,000	Dick, Kerr & Co., 1 to 260,000	1	10 %	10 %	6 %	5 %	3⅞ — 3¹⁵⁄₁₆	7/8 — 1	..	..	+ 1/32	5 0 0
305,000	Do. do. 6 % Cum. Pref., 1 to 305,000	1	6 %	6 %	6 %	6 %	1⅝ — 1¹³⁄₁₆	1⅝ — 1¹³⁄₁₆	..	..	+ 3/32	5 7 10
271,080	Do. do. 4½ % Deb. Stock	100	4½%	4½%	4½%	4½%	98 —101	98 —101	..	..	..	4 9 1
60,000	Dublin United Trams. (1896), 6 % Pref., 1 to 60,000	10	6 %	6 %	6 %	6 %	12½ — 13½	12½ — 13½	..	..	..	4 8 11
99,261	Edison & Swan Utd., "A" shs., £3 pd., 1 to 99,261	5	4½%	2½%	Nil	Nil	0 — ¼	0 — ¼	..	..	..	Nil
17,139	Do. "A" shares, 01—017,139	5	4½%	2½%	Nil	Nil	1 — 1½	1 — 1½	..	..	..	Nil
397,895	Do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	63 — 68	63 — 68	..	..	..	5 17 8
67,720	Do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	5 %	5 %	5 %	5 %	77 — 80	77 — 80	..	..	..	6 5 0
112,100	Electric Construction, 1 to 112,100	2	Nil	Nil	Nil	Nil	⅛ — ¼	⅛ — ¼	1 /7½	..	— ⅛	Nil
31,390	Do. do. 7 % Cum. Pref., 1 to 31,390	2	7 %	7 %	7 %	7 %	1⅝ — 1¾	1⅝ — 1¾	..	..	..	7 9 4
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	5 %	5 %	5 %	8⅛ — 8⅝	8⅛ — 8⅝	..	..	..	5 15 7
200,000	Do. do. 4 % Mort. Deb.	Stock	4 %	4 %	4 %	4 %	80 — 84	80 — 84	..	..	..	4 15 3
78,000	Gt. N. & City Rail. Pref. Ord. "A" 4 %, 1 to 78,000	10	4 %	½%	Nil	Nil	¾ — 1	¾ — 1	..	..	..	Nil
96,000	Greenwood & Batley, 7 % Cum. Pref.	10	7 %	7 %	7 %	7 %	10¼ — 10⅜	10¼ — 10⅜	..	..	..	6 10 3
80,000	Do. do. 5 % Mort. Debs.	100	5 %	5 %	5 %	5 %	102 —103½	102 —103½	..	..	..	4 16 10
40,000	Henley's (W.T.), Telegraph Works, Ord.	5	15 %	15 %	15 %	15 %	12½ — 12⅝	12½ — 12¾	..	..	..	5 17 8
40,000	Do. do. 4½ % Pref.	5	4½%	4½%	4½%	4½%	5 1/16 — 5 1/8	5 1/16 — 5 1/8	5 1/16	..	..	5 4 8
150,000	Do. do. 4½ % Mort. Deb Stock	Stock	4½%	4½%	4½%	4½%	107½—109½	106 —108 xd	..	..	— 1½	4 3 4
50,000	India-Rubber, Gutta-percha & Telegraph Works	10	10 %	10 %	10 %	10 %	15½ — 16	15½ — 16	..	..	..	6 5 0
37,500	†Liverpool Overhead Railway, Ord.	10	Nil	½%	Nil	Nil	1 — 1⅛	1 1/16 — 1 3/16	..	..	+ ⅛	Nil
10,000	† Do. do. Pref., fully paid	10	5 %	5 %	5 %	5 %	6¾ — 7¼	6¾ — 7¼	..	..	..	6 15 7
600,070	London United Trams. (1901) 1 to 50,007	10	3 %	3 %	Nil	..	1⅛ — 2⅛	1⅛ — 2⅛	..	..	..	Nil
399,930	Do. do. 60,008 to 100,000	10	3 %	3 %	Nil	..	1⅛ — 2⅛	1⅛ — 2⅛	..	..	..	Nil
125,000	Do. do. 5 % Cum. Pref., 1 to 125,000	10	5 %	5 %	3⅜%	Nil	1⅝ — 2⅛	1⅝ — 2⅛	..	..	..	..
1,649,380	Do. do. 4 % 1st Mort. Deb. Stock	100	4 %	4 %	4 %	4 %	67 — 71	67 — 71	69	68½	..	5 12 8
5,732,062	Metropolitan Consolidated	100	1 %	½%	½%	1 %	39⅞ — 40¼	39⅞ — 40	40⅜	39½	— ¼	2 10 0
2,640,914	Do. Surplus Lands	100	2¾%	2¾%	2¾%	2¾%	64 — 66	64 — 66	64½	64½	..	4 3 4
3,235,000	Do. District	100	Nil	Nil	Nil	Nil	25⅛ — 25⅜	26 — 26½	27	25⅝	+ ⅜	Nil
391,337	Metropolitan Electric Trams., Ord.	1	..	..	4½%	5%	1 13/16 — 1 15/16	1 1/16 — 1 13/16	16/3	..	..	6 3 1
314,016	Do. do. Defd.	1	Nil	Nil	Nil	..	⅛ — ¼	⅛ — ¼	..	..	..	Nil
500,000	Do. do. 5 % Cum. Pref.	1	5 %	5 %	5 %	5 %	29/32 — 15/16	29/32 — 15/16	17/8	..	..	5 9 7
595,600	Do. do. 4½ % Deb. Stock Red.	100	4½%	4½%	4½%	4½%	98 —101	98 —101	..	..	..	4 9 1
$10,923,200	Mexico Trams Co., Common Stock	..	..	..	..	6 %	123½ —125½	123 —125	124	..	— ½	4 16 0
$9,000,000	Do. 1st Mort. 50-year 5 % Gld. Bds.	..	..	..	5 %	5 %	96 — 98	96 — 98	97¾	97⅛	..	5 2 0
245,500	Potteries Electric Traction	1	4 %	4 %	Nil	..	1/16 — 1/8	1/16 — 1/8	5/6	..	..	..
245,500	Do. 5 % Cum. Pref.	1	5 %	5 %	5 %	5 %	⅜ — ½	⅜ — ½	10/3	..	..	7 5 5
245,000	Do. 4½ % Deb. Stock	100	4½%	4½%	4½%	4½%	80 — 83	80 — 83	..	..	..	5 8 5
37,350	Telegraph Construction and Maintenance	12	15 %	17½%	15 %	17½%	36 — 38	36½ — 38½	37½	..	+ ½	5 12 2
140,000	Do. 4 % Deb. Bds., 1 to 1,500 Red., 1909	100	4 %	4 %	4 %	4 %	101 —103	101 — 103	..	..	..	3 17 8
1,000,000	Underground Electric Railway, 5 % Prior Lien	..	..	..	5 %	..	100 —101	100 —101	100⅜	101⅛	..	4 19 0
2,800,000	Do. do. 4½ % Bonds.	..	..	..	4½%	4½%	94 — 96	94 — 96	95½	94⅛	..	4 13 9
4,900,000	Do. do. 6 % Income Bonds	..	..	..	..	..	37 — 39	38 — 40	38⅝	37⅛	+1	..
66,666	Willans & Robinson, 1 to 30,000 & 80,001 to 116,666	1	Nil	10 %	5 %	Nil	⅜ — ½	⅜ — ½	..	..	..	..
66,666	Do. 6 % C.P., 30,001 to 80,000 & 125,001 to 141,666	5	..	6 %	6 %	3 %	1 — 1½	1 — 1½	..	..	..	10 0 0
245,495	Do. 4 % 1st Mort. Deb. Stock	100	4 %	4 %	4 %	4 %	60 — 70	55 — 65	..	..	—5	6 3 1

ELECTRICITY SUPPLY COMPANIES.

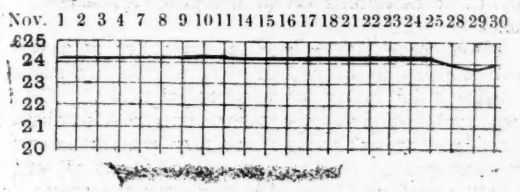
30,449	Brompton & Kens. Elec. Lt. Sup., Ord., 1 to 20,000	5	10%	10 %	10 %	10 %	6⅞ — 7⅛	6⅞ — 7⅛	7⅛	..	..	6 15 7
9,551	Do. do. 7 % Cum. Pref.	5	7 %	7 %	7 %	7 %	6⅞ — 7⅛	6⅞ — 7⅛	..	..	..	4 14 11
400,000	Central Electric Supply 4 % Guar. Deb. Stock	100	4 %	4 %	4 %	4 %	100 —103	99 —102 xd	..	..	..	3 18 5
80,000	Charing Cross and Strand Electricity Supply	5	5 %	5 %	5 %	5 %	3⅜ — 4⅛	3⅜ — 4⅛	75/-	..	..	5 19 5
80,000	Do. do. 4¼ % Cum. Pref.	5	4½%	4½%	4½%	4½%	4⅛ — 4⅜	4⅛ — 4⅜	87/6	..	..	4 17 4
80,000	Do. "City Undertaking" 4½ % Cum. Prf.	5	4½%	4½%	4½%	4½%	3⅞ — 4¼	3⅞ — 4¼	88/9	79/4½	..	5 5 11
445,736	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	97 — 99	97 — 99	..	..	..	4 2 6
9,486	Chelsea Electricity Supply, Ord.	5	4½%	4½%	4½%	4½%	3¼ — 3⅜	3¼ — 3⅜	70/-	..	..	6 0 0
175,000	Do. do. 4½ % Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	99 —101	99 —101	..	..	..	4 9 1
70,595	City of London Elec. Lighting, Ord. 40,001—110,595	10	6 %	6 %	6 %	7 %	11 — 11½	11 — 11½	11⅜	11	..	6 1 9
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	6 %	11½ — 12¼	11½ — 12¼	..	..	..	4 19 0
400,000	Do. 5 % Db. Stk.	Stock	5 %	5 %	5 %	5 %	120 —124	120 —124	..	..	..	4 0 8
800,000	Do. 4½ % 2nd. Db. Stk.	100	4½%	4½%	4½%	4½%	99½—102½	99½—102½	..	..	..	4 7 10
50,000	County of Durham Electrical Power, Ord.	5	4 %	2 %	Nil	Nil	1½ — 2	1½ — 2	..	..	..	Nil
50,000	Do. do. do. 5 % Pref.	5	5 %	5 %	5 %	5 %	2⅝ — 3⅛	2⅝ — 3⅛	..	..	..	7 16 10
250,000	Do. do. do. 5 % 1st Mtg. Deb.	Stock	..	..	5 %	5 %	94½ — 96½	94½ — 96½	..	..	..	5 3 8
40,000	County of London Electric Lighting, Ord. 1—40,000	10	5 %	5 %	5 %	5 %	7⅜ — 7⅝	7⅜ — 7⅝	..	..	..	6 7 0
55,000	Do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	6 %	10½ — 11⅛	10½ — 11	..	..	— ⅛	5 9 1
400,000	Do. do. 4½ % Deb. Stock	Stock	4½%	4½%	4½%	4½%	104½ —107½	104½ —107½	..	..	..	4 3 9
400,000	Do. do. 4½ % 2nd. Deb. Stock	Stock	4½%	4½%	4½%	4½%	98 —101	98 —101	100½	..	..	4 9 1
80,000	Edmundson's Electric Corporation, Ord. Shares	5	Nil	Nil	Nil	Nil	⅝ — ¾	⅝ — ¾	..	..	..	Nil
80,000	Do. do. 6 % Cum. Pref.	5	3 %	Nil	Nil	Nil	1¾ — 2	1¾ — 2	35 -	..	..	Nil
430,500	Do. do. 4½ % 1st Mort. Deb. Stk.	100	4½%	4½%	4½%	4½%	75 — 78	75 — 78	75	..	..	5 15 5
$8,150,000	Electrical Dev. Co. of Ontario, 5% 1st Mtg. Gold Bnds.	$500	..	..	5 %	5 %	81½ — 84¼	81½ — 84½	..	..	..	5 18 4
10,000	Folkestone, 1 to 10,000	5	5½%	5½%	5½%	5½%	4½ — 4⅝	4½ — 4⅝	..	..	..	5 12 10
10,000	Do. 5 % Cum. Pref., 1 to 10,000	5	5 %	5 %	5 %	5 %	4⅝ — 5⅛	4⅝ — 5⅛	..	..	..	4 11 11
90,000	Do. 4½ % 1st Deb. Stock	100	4½%	4½%	4½%	4½%	99 —102	99 —102	..	..	..	4 8 3
15,000	Hove, 1 to 15,000	5	9 %	8½%	8⅝%	8⅝%	6½ — 7	6⅝ — 7	..	..	..	6 1 5
$1,376,000	Kaministiquia Power Co., 5 % Gold Bnds.	100	..	..	5 %	5 %	103½ —105½	10 3/4 —105½	104¼	..	..	4 14 9
21,000	Kensington and Knightsbridge Electric Ord.	5	10 %	10 %	8 %	8 %	6⅝ — 7	6⅝ — 7	..	..	..	5 14 3
90,000	Do. do. do. 4 % Deben. Stk.	Stock	4 %	4 %	4 %	4 %	93 — 95	93 — 95	..	..	..	4 4 3
11,000	London Electric Supply Corporation, Limited, Ord.	3	4 %	2 %	3 %	..	1⅜ — 1⅝	1⅜ — 1⅝	..	..	..	5 2 2
70,000	Do. do. do. 6 % Pref.	5	6 %	6 %	6 %	..	4⅝ — 5⅛	4⅝ — 5⅛	..	..	..	5 17 1
382,355	Do. do. 4 % 1st Mort. Deb. Stk. Red.	Stock	4½ %	4 %	4 %	4 %	90 — 93	90 — 93	..	..	..	4 6 0
200,000	Metropolitan Electric Supply, 1 to 100,000	5	8 %	6½%	5 %	5 %	3¼ — 3⅜	3¼ — 3⅜	67/6	65/-	..	6 17 11
76,121	Do. 4½ % Cum. Pref. 1—71,106	5	4½%	4½%	4½%	4½%	4⅛ — 4⅜	4⅛ — 4⅜	..	..	..	4 17 4
235,000	Do. 4½ % 1st Mort. Deben. Stock	Stock	4½%	4 %	4½%	4½%	102 —105	102 —105	..	..	..	4 5 9
248,000	Do. 3½ % Mort. Deben. Stock Redem.	Stock	3½%	3½%	3½%	3½%	82 — 85	82 — 85	..	..	..	4 2 4
$6,000,000	Mexican Electric Light Co., 5% 1st Mtg. Gold Bnds	100	5 %	5 %	5 %	5 %	88 — 89	88 — 89	88½	88¼	..	5 10 6
18,585,000	Do. Light and Power Co., Ltd., Common	$100	..	4 %	3½%	4 %	87½ — 89½	87½ — 89½	89⅜	..	..	4 9 5
$2,400,000	Do. do. 7% Cum. Pref. Stk.	Stock	..	..	7 %	7 %	104 —106	104 —106	105⅛	105	..	6 12 1
12,000,000	Do. do. 5½ % 1st Mtg. Gold Bnds.	100	..	..	5 %	5 %	92 — 93	91½ — 92⅝	92⅝	91⅞	— ⅛	5 7 10
250,000	Midland Electric Corporation, 4½ % 1st Mort. Deb.	100	4½%	4½%	4½%	4½%	96 — 98	97 — 99	..	..	+1	4 10 11
130,491	Newcastle-on-Tyne, 1 to 137,500	5	8 %	8 %	2½%	..	3⅜ — 4⅛	3⅜ — 4⅛	..	..	..	2 12 9
137,500	Do. 5 % Pref., 1 to 137,500	5	5 %	5 %	5 %	5 %	4⅜ — 4⅝	4⅜ — 4⅝	..	..	..	5 2 7
150,000	North Metropolitan Electric Power Supply Co., 5 % Mortgages (Red.), Nos. 1 to 1,500	100	..	..	..	5 %	97½ — 99½	97½ — 99½	..	..	..	5 0 6
10,852	Notting Hill Electric Lighting	10	7½%	7½%	7 %	..	12 — 13	12 — 13	..	..	..	5 7 8
20,000	Oxford, 1 to 96 and 407 to 20,310	5	7 %	7 %	7 %	7 %	6¼ — 6⅝	6¼ — 6⅝	6½	6⅜	..	5 3 8
119,694	River Plate Elcty. Co. Ord.	Stock	2½%	6 %	8 %	9 %	225 —235	228—238	234½	..	+3	3 15 8
100,000	Do. do. 6% Non Cum. Pref.	Stock	6 %	6 %	6 %	6 %	100 —110	100—110	..	..	..	5 9 1
200,000	Do. do. 5% Deb. Stk. Red.	100	5 %	5 %	5 %	5 %	100½—102½	100½—102½	..	..	..	4 17 7
40,000	St. James' and Pall Mall Electric Light, Ord.	5	10 %	10 %	10 %	10 %	7⅛ — 8	7⅛ — 8	7⅞	7½	..	6 5 0
20,000	Do. do. 7 % Pref. 20,081 to 40,080	5	7 %	7 %	7 %	7 %	6¼ — 7⅜	6¼ — 7⅜	..	..	..	4 14 1
150,000	Do. do. 3½ % Deb. Stock Red.	100	3½%	3½%	3½%	3½%	86 — 88	86 — 88	..	..	..	3 19 7
12,000	Smithfield Markets Electric Supply, Ord.	5	Nil	Nil	Nil	..	1½ — 2	1½ — 2	..	..	..	Nil
65,000	South London Electric Supply, Ord.	4	3 %	4 %	5 %	5 %	2⅝ — 3	2⅝ — 3	..	..	..	6 13 4
180,100	Do. do. 5 % 1st Mort. Deb.	100	..	..	5 %	5 %	100 —103	100 —103	..	..	..	4 17 1
120,000	South Met. Elec. Lt. & Power, Ord.	1	2½%	2½%	2½%	..	⅜ — ½	⅜ — ½	..	..	..	Nil
142,968	Do. do. 7 % Pref.	1	7 %	7 %	7 %	7 %	29/32 — 1 1/32	29/32 — 1 1/32	..	..	..	6 16 7
224,530	Do. do. 4½ % 1st Deb. Stk.	100	4½%	4½%	4½%	4½%	96 — 99	96 — 99	..	..	..	4 10 11
80,000	Urban Electric Supply, Ord.	5	5 %	5 %	5 %	..	¾ — 1	¾ — 1	..	..	..	20 0 0
50,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	..	2 — 2½	2 — 2½	..	..	..	10 0 0
275,000	Do. do. 4½ % 1st Mort. Db. Stk. Red.	100	4½%	4½%	4½%	4½%	80 — 82	82 — 84	..	..	+2	5 7 2
808,000	Victoria Falls Power Co., Pref. Nos. 1 to 808,000	1	..	..	5 %	..	⅜ — ⅞	⅜ — ¼	..	..	..	5 14 3
100,000	Westminster Electric Supply, Ord.	5	12 %	10 %	10 %	10 %	7½ — 8½	7½ — 8	7¾	7½	— ¼	6 5 0
51,279	Do. do. 4½ % Cum. Pref. (Reduced from 5% since 31st Dec., 1905)	5	4½%	4½%	4½%	4½%	5 — 5½	5 — 5½	..	..	..	4 1 10

* Unless otherwise stated, all shares are fully paid. † Quotations on Liverpool Stock Exchange.

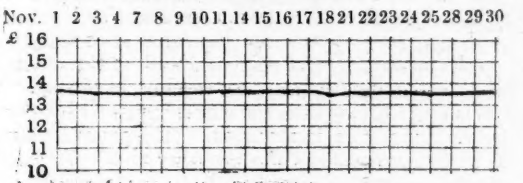
METAL MARKET.

Fluctuations in November.

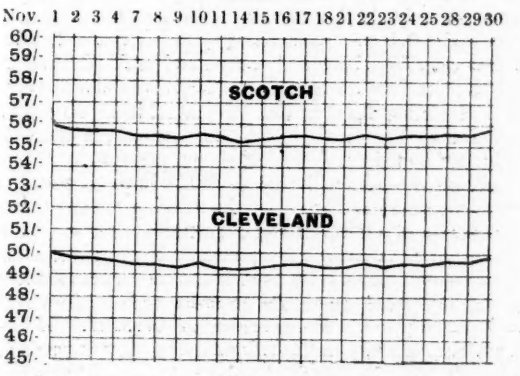
SPELTER (G.O.B's.).



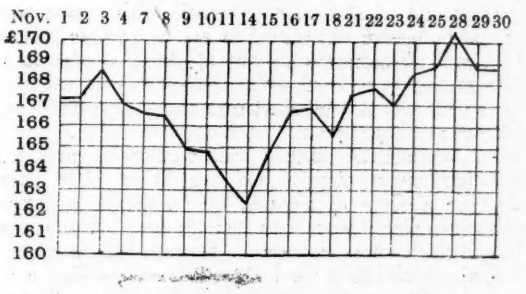
LEAD (ENGLISH).



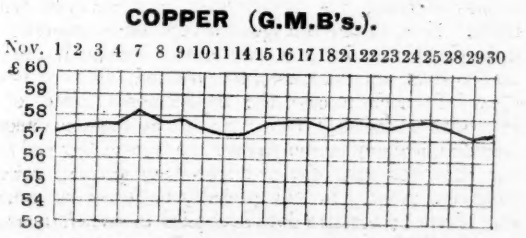
IRON.



TIN.



COPPER (G.M.B's.).



Electric Power in Canada.—The Ontario Government and the Hydro-Electric Commission have conferred on the proposed extension of the line from St. Thomas to Windsor, at a cost of $1,000,000. The proposed exportation of power to Detroit, Michigan, is also under consideration. As the local demand will not equal the supply, it will make it all the cheaper for Canadians if the surplus can be marketed in the States at an advance figure.

Work has been started on the development of a hydro-electric plant at Sandy Falls, in the new Porcupine gold district, north of Cobalt. A 3,000-H.P. plant has been ordered for delivery by June 1st next. Current will be generated at a pressure of 12,000 volts. This will give an impetus to gold mining in the Porcupine district, which is destined to be a great gold camp.

SOME POINTS IN CONNECTION WITH TRANSFORMERS.

[COMMUNICATED.]

The point of view of the man who has to deal with the operation of electrical machinery is very frequently somewhat different to that of the man who designs or constructs the plant. To a certain extent all three classes of engineers must necessarily work together for the common good of all, but where one consideration has to be opposed to another and a design involves a compromise, it sometimes happens that unless the plant is made to a rigid specification based immediately upon operating experiences and conditions, there is a great tendency for the question of cost to have an undue influence upon the design. Moreover, owing to the fact that there is perhaps more interest in reading a highly logical exposition of technical theory than a bald statement of practical trial and possible breakdown, it is more usual to find the space of technical journals occupied by the former rather than the latter type of article, and it may therefore be said that, speaking broadly, the actual running experience in relation to electrical plant is not so widely known as might be desirable in the general interest of electrical science.

These preliminary remarks are not intended as a criticism of the technical value of our journals, but rather in the nature of an explanation almost akin to an apology for placing before technical men what is, after all, a bare statement of practical experience in relation to static transformers, with no attempt to enter fully into the theory of the matter.

A considerable amount has been written of late upon the ageing effect of the iron used in transformer cores, and the evils of an injudicious choice of iron from this point of view in gradually increasing the hysteresis loss of the transformer by this means has been demonstrated. The actual practical effects upon the working of transformers have, however, hardly been sufficiently realised. Hysteresis loss implies increased heating of the whole transformer, and this, especially if the transformer is placed in a confined situation, where the air is not in free circulation, as, for example, in a small transformer sub-station, placed under the street, may easily be very considerable. In such cases the heating of transformers has become so excessive that it has become necessary to slack back the bolts holding the covers to the transformer cases and to keep the covers raised about 1½ in. from the top of the transformer in order to allow heated air to escape, by resting the covers on the top of the studs. This is a very dangerous practice, as not only is there the danger of foreign substances being accidently introduced into the interior of the transformer cases, but there is actual risk of human life. In one case an experienced man who was leaning against one of these transformers unconsciously allowed his fingers to get under the cover, and stood for some minutes with half his hand inside the transformer case until his attention was called to the matter. Fortunately he sustained no injury, but he might easily have done so, for in the usual construction of such transformers the high-tension terminals are quite bare and are frequently only about 2 in. from the top of the case.

Not only is this the case, but where the lids are raised in this way the transformer, even if oil insulated, is liable to serious trouble should it be placed in a humid atmosphere. There is the liability of water condensing on the surface of the oil when the transformer is not working, or of water being splashed into the interior of the transformer when the sub-station is being cleaned. In such a case the water will provide a most excellent leakage path, which can easily be a very dangerous matter. In order to avoid danger from the cause mentioned above, it is advisable in testing new transformers to insist on an extremely low temperature rise after six hours' work at full load. Where the transformer is insulated by means of air and not oil, it is advisable to distrust the indication of a thermometer, and the rise of temperature should be taken by measuring the increase of electrical resistance. In some instances a difference of 20 per cent. in the results obtained by the thermometric and electrical resistance methods of testing have been obtained. In practice it may be taken that if a transformer will run under the normal

conditions as regards its surroundings for six hours at full load, with a temperature rise which does not exceed 70° F. at any part, it is not likely than any future trouble will be experienced due to overheating.

It may be imagined from the above notes that the engineer who has transformers which, unless they are treated in the manner above indicated, get very hot, is saddled with plant which is unworkable, or which, at any rate, can only be used on very low loads. As a matter of experience, however, this has been found in many cases to be incorrect. Many of the older manufacturers of transformers, before they knew sufficient about the theory of design to enable them to cut down their standards to very fine limits, erred on the safe side, and built very strongly and well. The result is that some of the older transformers will stand conditions of working that appear perfectly marvellous to us to-day. In one small sub-station, which is by no means too well ventilated, and therefore gets very hot, there are two transformers which have been working for nearly five years day and night without a single rest. During the evening, when the heavy lighting load is obtained, they are able to carry an average overload of about 25 per cent. These transformers never have the chance to get cool, and, as a matter of fact, they are always too hot to bear one's hand on with any comfort; in spite of this they perform their work without trouble and without intermission, a record of which any maker of transformers might be proud.

It seems almost superfluous to say that this question of over loading is a matter of extreme importance in practice, more especially upon lighting systems where there is a possibility of a heavy evening load for a short period. The way in which this practically affects the running of an electricity supply system may, however, be demonstrated. In order to eliminate no-load loss as much as possible, it is good practice to switch out transformers at sub-stations both on the primary and secondary as soon as the load can be safely carried by the transformer left in circuit. This means that during the daytime there will probably be one transformer left in operation in each sub-station on a widely extended system, and this entails that certain attendants have to make a round of the smaller sub-stations in order to switch in extra transformers in time for the evening load. Usually they can so adjust their round as to get all the extra transformers into circuit before the evening load comes on. In one instance, however, a rather sudden descent of darkness brought forward the time of the evening load considerably. The man employed on the system affected, whose duty it was to look after the sub-station, had a round to do every afternoon which caused him to return to the main sub-station in order to switch in extra transformers for the night load. On this occasion in the winter time it got dark so suddenly that by the time the first attendant reached the main sub-station, the transformer which was in operation at the time was over loaded by over 50 per cent., and a few minutes more of increasing load would probably have meant the burning out of the transformer. As a partial safeguard the regulations of the supply system were adjusted so that whenever it was in the least likely that darkness would come on before the usual time, two transformers were left in circuit at each important sub-station. This, however, is not an absolute safeguard, and the true test of safety is that the transformer will stand heavy overload without over-heating and breakdown.

A very important point in regard to the heating of transformers is the influence which this may have on the oil insulating medium where this is used. Where there is excessive heat such oil is very liable to vaporise slowly, and should the covers be lifted, or even should the cables be led into the case through loosely fitting glands, this vapour will escape through the apertures provided in this way, and will condense upon surrounding objects. In combination with any dirt which happens to be floating in the atmosphere, this forms a sticky, gummy deposit, and its influence upon adjacent switchgear is very bad indeed, as the deposit is very difficult to remove. Not only is the appearance of a switchboard utterly ruined by such a deposit upon polished slate, but there is great danger of the effective insulation between adjacent metallic surfaces being seriously impaired by the contained dirt. For this reason, if for no other, an attempt should be made to keep the transformer cool if possible, either by periods of rest or by artificial cooling devices, inasmuch as the constant evaporation of oil constitutes an insidious and growing defect, which, if not properly watched, will cause the level of the oil in the transformer case to become too low to give the necessary insulation to the windings. Another remedy which may be alternatively adopted is to use a transformer oil of a higher vaporising and flash point.

These considerations lead to the notice of a very important point in connection with transformer sub-station practice which is far too frequently ignored. The transformer sub-station may, for example, be erected in order to feed a residential neighbourhood, and may continue in operation for some years. At the first an equipment of, say, two 50-KW. transformers may be ample for the supply to the neighbourhood, and so long as the sub-station does its work, very little more than ordinary routine attention is paid to it. Two things may happen: the popularity of electricity may be on the increase in the neighbourhood, or the number of houses in the district may be steadily increasing. The result is that little by little and almost imperceptibly the load upon the sub-station is increased. The gradual nature of such an increase prevents the necessary care being exercised to see that the station capacity is not being exceeded. Had the load increased by leaps and bounds, care would have been taken to have tested the nature of the load upon the transformer at short intervals. As it is, the matter is probably allowed to rest until very possibly the low-tension transformer fuses blow and cause considerable inconvenience. When ammeters are brought to the sub-station for the purpose of testing the condition of affairs, it is very probably found that the average night load upon the transformers is 50 per cent. in excess of their proper full load, and this condition of affairs will very probably have to remain until sufficient time has elapsed for the ordering, manufacture, and installation of additional transformers. Such an instance is of very serious consequence, inasmuch as the test usually comes upon a sub-station at or about the commencement of a winter load when there are no spare transformers available and all the running conditions are most critical. This points most emphatically to the advisability of installing ammeters upon the main low-tension bus-bars of every distributing sub-station, however small, and of instituting a routine check of the readings on such instruments.

In conclusion, a word may be said with regard to some of the protective devices which are adopted in connection with static transformers. One of the most usual forms of such protective or earthing devices consists of two circular brass plates about $\frac{1}{4}$ in. apart from each other, and insulated from one onother by a rim or hoop of vulcanite. One plate is earthed, and the other is connected to the outer wire of the low-tension circuit. On the lower plate there is attached a piece of tin foil, which, should an excess of voltage be placed upon the upper plate, is attracted towards it, and this makes a connection between the two disks. As a result, should there be leakage between the high and low-tension circuits, the transformer windings are put to earth. Now, if the leakage is a very large one (and it is quite possible to obtain a very heavy leakage if the high-tension coils are defective), the tin foil will very possibly fuse. In such a case the undischarged plate of the protective device may be maintained at quite a dangerous potential, and any person passing the transformer and touching the protective device might very possibly receive a dangerous shock. It will probably be found on examination of most protective devices applied to transformers, that they are liable to breakdowns of quite as serious a nature as in the case above described, and this points to the fact that while a protective device should never be omitted from the equipment on a high-tension transformer, it is advisable to safeguard the protecting device from accidental contact, either by placing it in such a position that it cannot be inadvertently touched or else by shielding it with an insulating material.

It will be seen from the above notes, which are necessarily somewhat cursory in character, that a good deal of trouble may be experienced in running transformers owing to operating conditions of which the original designer knows little or nothing. As it is to the interests of everybody concerned in the supply and distribution of electrical energy to ensure

that the chances of breakdown are minimised as much as possible, it is hoped that the above notes will lead to a consideration of the qualities of the transformer from the point of view of the operating engineer, that will tend toward further improvements in the design of this most important piece of electrical apparatus.

THE REVIVAL OF APPRENTICESHIP.

By G. BASIL BARHAM, A.M.I.E.E.

The Lord Mayor of London recently gave expression to the opinion that the revival of the old English system of apprenticeship would be to the industrial advantage of the country, and his remarks have had, as it were, the effect of crystallising impressions which have been forming for some years in the minds of those who are brought into close contact with electrical manufacturing work.

It is not the object of the writer to enter into a general consideration of the merits and demerits of apprenticeship, but rather to deal with the question as it affects the electrical industry. But before doing so, it will be advisable to glance at what is already being done in other trades in order to gain some idea as to whether it is feasible to extend the system in the directions of electrical manufacturing and contracting.

It has been said that the virtual abolition of apprenticeship, with the lack of anything to take its place, is a fertile source of unemployment, and the suggestion of Sir John Knill was that employers should indenture youths, take a personal interest in their welfare, and maintain a supervision equal to that of a parent. The old English system included the provision of board and lodging by the master; but it would seem that it would be impracticable to carry out, in these modern times, every detail of a system which undoubtedly worked well under the conditions then obtaining.

In England, for some time past, many large engineering firms have been giving attention to the close relationship between workshop and technical school training, and have been bringing their apprentices more into touch with the various polytechnics and the Government Science and Art classes.

Several of the larger engineering firms, such as Messrs. Vickers, Sons & Maxim and Messrs. Yarrow, have introduced what is termed the sandwich system of time off during the winter months for their apprentices, in order that they may receive an adequate amount of systematic technical education.

It is now becoming generally felt that the system which was in vogue a few years ago, which involved an elementary school course until the boy was 14, with another four years at a high school, and four more at a technical college where the training was industrial and not academic, followed by two years in a workshop as an industrial cadet, was open to serious objection, inasmuch as the apprentice would have reached the age of five and twenty before he was in a position to earn his own living.

On the other hand, the system in which the boy is left to himself, receiving workshop training during the day and being supposed to attend technical classes during the evening, is certainly open to more serious objection still, for only a very small percentage of apprentices can be relied upon to take full advantage of the evening tuition. Further, although the number of technical schools has increased during recent years, the course of training is comparatively short, usually lasting for three years only; and as many of the students are found, on admission, not to have received a sound general education, the results are often disappointing.

A certain large engineering firm has recently inaugurated at its works a course of post-graduate lectures by capable engineers employed upon the staff of the firm, in order that its apprentice *corps* should be thoroughly grounded in the business of the company. At least 12 lectures per annum are given to the pupils by an expert in the particular subject under consideration. For example, a lecture may be given on hydraulic turbines, in which the history of these prime-movers will be exhaustively dealt with, the more recent designs compared with those of earlier date, and reasons given for the changes that have been made; and the lecturer will conclude by showing to what extent the complex laws which govern the behaviour of water may be simplified or modified so as to render them easily applicable to any specific type of turbine or wheel designed for a particular purpose. On the next evening set apart for a technical lecture, the subject may be the use of machine tools, and the lecturer will point out the relative advantages and disadvantages of high and slow-speed machines, touch upon the various duties performed by drilling, slotting, milling, shaping or planing machines, illustrate some early forms of these appliances, and, incidentally, deal with such questions as the design of cutting tools and their hardening and tempering. Other lectures might be on the design of alternating-current generating plant; the design, construction and use of transformers; or the different forms of valve gear used with various types of engines. It can be readily seen that by thus training the young engineers, who will in course of time take the places of the older men, the firm is adopting a very sound policy.

It is now some three years ago since a leading British engineering firm, Messrs. Clayton & Shuttleworth, Ltd., after a close study of the old apprenticeship systems, inaugurated a scheme which has much to commend it. Under this system, the apprentices are indentured at any time between the ages of 15 and 21. Premium pupils are not taken, and equal treatment is given to all. As soon as a boy becomes proficient in one branch, he is transferred to another department, and throughout the scheme the two chief aims have been to supplement the shop work with courses of instruction directly bearing upon the work in the shops, and to give a varied shop experience to all apprentices who proved themselves worthy. As it is recognised that the desire for learning is rarely sufficient incentive in itself, the firm pay wages at rates which compare favourably with those paid for youths' work in shops where little or no attention is paid to their tuition. The scale of wages is further supplemented by a scale of increases or awards depending solely upon merit. In order to simplify the system of payment as much as possible, all apprentices are divided into three classes, of which the first contains those who are receiving the ordinary rate of pay; the second, those receiving an extra 1s. per week; whilst the third comprises those who, by reason of having shown exceptional merit, receive a still greater increase over the ordinary rate.

A fully qualified engineer is appointed to take charge of the apprentices, and he devotes the whole of his time to supervising their work, teaching them new methods of carrying out their duties, and grounding them thoroughly in the various underlying principles. It is his business to promote those boys whom he considers eligible. The firm maintains its own school in the works, and as no charge is made for tuition, all apprentices are expected to attend the classes, and all books and utensils are provided by the firm. The instruction includes general machining and turning, fitting and erecting, tool-making, pattern-making, joinery, wheelwrighting and general carpentering work, moulding, smith's work, and boiler-making. An apprentice is placed in one or other of these sections when starting, and in the ordinary course of events is not transferred to another trade during his indentured term. But he is given opportunities, as far as possible, of becoming acquainted with the technique of those other trades which are most closely allied to that in which he is engaged.

It is not to be expected that every apprentice takes full advantage of the opportunities offered, but to those who show by their efforts and natural ability that they possess those qualifications which fit them for more responsible positions, will be given opportunities of becoming acquainted with the higher branches of works management and administration. They will be granted facilities for gaining experience in the drawing office, stores, and jig and special tool departments, in costing work, economical manufacturing methods, and general works management. But even where an apprentice shows little or no aptitude, the superintending engineer is expected to do his utmost to advance the boy's general and technical knowledge.

Some little time ago Major O'Meara delivered a lecture to the members of the Post Office Institution of Electrical

Engineers on the Training of Engineers and Artisans. In the course of his remarks, he placed in order of importance the qualifications that, in his opinion, were essential to ultimate success. Principal amongst them were initiative, mental capacity, trustworthiness, tact, resourcefulness, perseverance, commercial aptitude, administrative ability, and professional knowledge. He urged that the student's time should be devoted to a study of each of the various subjects affecting his profession in accordance with their relative value to his work. In many youths there is no doubt that several of the qualities enumerated as essential for the successful man exist in a marked degree; and properly trained and technically educated in a sound manner, there is no reason why a greater proportion of apprentices than hitherto should not be turned out of the shops in a highly efficient state. Under the modern prevailing system of pitchforking a boy into a business, and allowing him to make or mar his career, of leaving it open to him either to work or to play, of employing him on any odd job when there is work to be done, and discharging him as soon as work grows slack, not only are his qualifications for success discouraged and their growth stunted, but frequently they are stamped out altogether.

It may be asked whether a revival of the apprenticeship system would benefit the electrical industry. Whilst realising the difficulties which lie in the way, the writer has no hesitation in answering in the affirmative. Wherever a scientific system has been adopted its advantages have been demonstrated in a marked degree. At least one large American firm of electrical engineers have established a school at their factory for training and educating their apprentices, and, indeed, all other workmen employed by them who desire to take advantage of the facilities offered. At first the firm tried the plan of assigning different groups of boys to different departments, and there training them by specialist instructors. It was found, however, that the productive conditions in the departments tended to interfere with the training. The rate of production was necessarily so great as to prevent the slower boys from keeping pace with it, the departments existing primarily for the output of finished articles, and not as centres of instruction. Hence it was decided to set aside a special apartment for the purpose of technical training, and it is said that the results of the first few years' working have been most satisfactory. For the training of machinists 10,000 sq. ft. of floor space have been allotted, with over 100 representative machine tools installed therein, and in this room all the work done is of a commercial nature. Embryo pattern-makers have a shop with over 1,000 sq. ft. of machine and tool area in which to learn their business. It is said that two years in the machine shop under the special instructors, and another two years in the other different departments, suffice to turn out a workman of trained skill and intelligence, and more than ordinary ability.

It has been urged by some of those with whom the writer has been in conversation regarding the present subject that, although a revival of the apprenticeship system might be of advantage in electrical manufacturing, it could not be beneficial to any extent in the electrical contracting business. To the writer, the statement seems to be based on an insufficient examination of the position of the contracting side of the trade; and a deeper consideration should show that if the boys employed in the trade, or a large percentage of them, were indentured for a term of years, the positions of all concerned would be improved. At present boys are employed in the business in a very haphazard manner. They are allowed to gain a little practical knowledge, and as soon as business falls slack, or they desire a few shillings increase in their weekly wages, they are discharged. They drift into the employ of another firm, and claiming a greater knowledge than they possess, are treated at first as being almost qualified wiremen. In a few weeks or months they are again out of a situation, and when another is found, they claim to be, and are treated as, experienced wiremen. The job is carried out somehow, and the youth goes away to appear in a few weeks or months as a jerry contractor with a scanty kit of tools and a few pounds credit.

There is no doubt that this treatment of boys employed in the electrical contracting business has a bad effect all round. Appearing in borrowed plumes amidst qualified wiremen, the incompetent boy brings discredit upon a very capable class of workmen; posing as a contractor he brings a skilled trade into disrepute. Reputations are imperilled, prices are cut, work is scamped, and the industry is lowered; all of which might have been avoided had the boy been indentured to, and properly trained by, his first employer.

SOME RECENT COMPENSATION CASES.

[FROM OUR LEGAL CONTRIBUTOR.]

An elaborate treatise might be written on the Workmen's Compensation Act, as this famous measure has been interpreted in the Courts during the last 12 months. In spite of the lapse of time, in which one might have thought all doubtful points would have been set at rest, conundrums are still being daily propounded for solution. True, the simple question generally is—How much? But we have recently come across several decisions which go much deeper than this. A word or two about them may be of interest to our readers. We shall not, as a general rule, trouble to give the names of cases, but chapter and verse can be given if necessary.

The first case which has struck us as being of more than passing interest, relates to the financial position of employers. If an employer is poor—too poor even to insure what shall happen to him if an order is made that he shall pay 10s. a week to an injured workman, or a lump sum down? There is nothing for it but the bankruptcy court. In a case recently heard at Bristol an order to pay 8s. a week was made upon a man who had nothing and was looking for employment himself. The judge wisely suggested that the applicant should settle for what he could get, otherwise the "employer" would be driven into the bankruptcy court.

It is said that hard cases make bad law; this is a good example of the truth of the maxim.

Amongst what may be termed "medical" cases, there been many which demonstrate the enormous importance to the employer of having a reliable medical opinion upon every case. There is so much malingering abroad that it is impossible to be too careful.

A striking example of "malingering" is reported from Manchester. A man who was employed by a railway company met with an accident which, he said, partially disabled him. Each week he used to limp along to the office and draw his compensation. Eventually, however, his solicitor wrote saying that he would be glad to accept a lump sum of £50 in full settlement. The railway company then looked into the matter, and while the inquiries were being prosecuted, a report appeared in which the same man figured as applicant for compensation from a hospital, in the employment of which he was injured. An award had to be made in his favour in the latter case; but he was subsequently prosecuted by the railway company and convicted of obtaining money by false pretences.

Here was a case in which medical examination might have revealed the fact that the man was malingering. The following "medical" cases may also be mentioned.

At Marylebone it was held that a man who suffered from neurasthenia as the result of a blow, was the victim of an accident. In Scotland a charwoman, who complained that she could not use her arm, was refused compensation on the ground that the loss of power was due to her neglect to exercise her arm. In another case, which was heard at Cardiff, it appears that some time after receiving a blow on the head, the applicant became lunatic. Owing, however, to the medical evidence, he failed to establish that the lunacy was caused by the accident.

The above cases, which are taken quite at random, show the infinite variety of the problems which may have to be solved wholly by medical evidence. Where the applicant is relying on medical testimony, he must be prepared to show that the injury or death, as the case may be, is due to accident. If it is merely consistent with natural causes, there can be no compensation. For instance, in a case at

Crewe, it was alleged that a gas fitter, who died three days after an explosion, was the victim of poisoning by carbon monoxide, and that he had therefore met his death by accident. The judge held otherwise, because it was proved by the medical men that if death was the result of "gassing," immediate hæmorrhage would have resulted, whereas it did not occur until three days afterwards. He, therefore, held that death was due to natural causes.

Coming next to cases which are of legal rather than medical interest, we have to record one which, if followed, may have considerable bearing on the future working of the Act. Hitherto many employers have thought that they are responsible for every accident which causes injury, no matter who is really to blame. Of course, their liability is diminished if the accident was due to the serious and wilful misconduct of the workman himself; but there is a section which, if it continues to receive the interpretation recently put upon it by a County Court Judge, will go far to lessen the employers' liability. It appeared that two men were in charge of a spinning mule with a boy under them. Having ordered the boy to clean the machine, one of them negligently started it, with the result that the boy was injured. The employers had to pay him compensation. But there is a section in the Act which says that "where the injury is caused in circumstances which create a legal liability in some person other than the employer," the employer may claim an indemnity. Relying on this provision the employers sued the two workmen. Judge Bradbury, at Oldham, held that they were entitled to recover. Whether they will recover in fact, as well as in law, depends on the financial position of the workmen; but the case is useful as showing that workmen who are in a responsible position, cannot be negligent, and then leave their employer to pay compensation.

As showing the extent to which an employer may be called upon to pay compensation, reference may be made to the West Stanley Colliery case, which was recently before the House of Lords. In one of those disasters which are all too frequent in coal mines, a father and two sons were killed. It appeared that their wages were all paid into a common fund, and the widowed mother claimed to be dependent on, and entitled to compensation in respect of, all three. The Court of Appeal, affirming the decision of the County Court Judge, held that as the widow was in law dependent on her deceased husband, she could not be said to be dependent on the sons as well, and that, therefore, her claim to compensation was limited to what she could have claimed had her husband alone been killed. The House of Lords, however, have reversed this decision, holding that she was also dependent on the sons, and was entitled to compensation in respect of their deaths. What the total amounted to does not appear from the report; but it would have to be "reasonable and proportionate to the injury" to the widow and the other children.

One other case remains to be noted. Where a workman who is partially disabled is in receipt of weekly compensation, the county court judge will generally make an award based on the assumption that the man can do a certain amount of work. Sometimes, if he thinks that the injury is not serious, he will reduce the payment to a nominal amount. Yet even if there is no physical change in the condition of a workman, the county court judge has power to review his own decision if he is satisfied that the man is finding it difficult to find work.

The Court of Appeal have said that while the mere fluctuations of the labour market are not to be regarded, the County Court judges are bound to recognise the fact that employers are loath to take into their service men who are even partially disabled.

Reduction of Capital.—Horsfall Destructor Co., Ltd.—A petition for confirmation of the reduction of the capital of this company from £100,000 to £60,725 is to be heard in London on December 13th.

Fire.—Early on Friday morning last a portion of the factory of Messrs. Ross, Courtney & Co., Ltd., Upper Holloway, was seriously damaged by fire. The offices and stores were not destroyed. The firm have already secured another factory in Ashbrook Road (not far away), and they hope to be in a position to deal promptly with orders in the course of a few days. In the meantime they ask for the indulgence of the trade.

COMBINED DESTRUCTOR AND ELECTRICITY WORKS.

By E. KILBURN SCOTT, M.I.E.E.

When it was first proposed to utilise the heat from refuse destructors to raise steam for electricity works, the idea looked so promising on paper that a crop of exaggerated statements resulted. Afterwards there was a reaction, and combined plants were decried in a manner that was no more justified than the previous exaggerations.

Time is, however, the great solver of problems, and looking back over a dozen years to the starting of the Shoreditch plant, it must be admitted that the combined destructor and electricity works has given excellent results.

In this country alone there are 80 such plants, and they are being added to at the rate of about 20 per annum. The idea has caught on in the Colonies, and in far-off New Zealand, for example, there are two successful plants at Christchurch and Auckland. Germany has also several plants, and the United States is somewhat tardily recognising that there is something in the idea. One of the most recent plants erected at Milwaukee burns 300 tons per day.

It is now generally recognised that destruction by fire is the most sanitary way of dealing with refuse, and that although the latter varies very much, its average calorific value can be taken at about ⅓th that of good bituminous coal. Allowing the amount of refuse per 1,000 inhabitants is about 20 cwt. per day, and this is equal to giving about 300 lb. of steam per hour for nine hours per day, if burnt in a properly designed destructor.

Although the calorific value is so small, it is an undoubted fact that some of the lowest fuel costs for electricity works are obtained where steam from refuse destructors is used; as, for example, at Hackney (the lowest in London), St. Helens and Partick.

The number of Board of Trade units per ton over a whole year's working varies with different plants; 50 seems an average figure, which any moderately well managed combined plant might attain to, and 97 has been reached on an 8-hour test.

The following summary of the data that have been given in various papers and articles may be useful:—

Site.—The site should be considered principally from the point of view of collection and delivery of refuse, so as not to cause a nuisance. At the same time, if there is a choice of two or more sites about equal from the refuse point of view, then that which is most favourable for water supply and saving in cables should be chosen for the sake of the electrical side. Where there is a canal it may very well run between the two buildings, as at Coventry.

Quality of Refuse.—The best refuse comes from the poorer districts and the factories of large towns. Winter refuse has the highest calorific value, because of the partly-burnt cinders from house fires. On the other hand, the refuse and garbage is wetter than during the summer. To get the best results out of a destructor, the refuse should be brought in methodically every day. To tide over Sunday a storage bin should be provided.

Charging.—The charging of the refuse should be effected mechanically with a minimum of labour, and so that the men need not come in contact with it. The wet garbage should be kept away from the ashes and the dry refuse, and time given for the bulk of the free water, which may be as much as 10 per cent. in winter, to drain away to the sewer. The refuse should be gradually fed forward to the fire grate, being first dumped on to a strongly-built hearth that will take the impact safely, and kept there some time to dry out.

Dust.—Taking all things into consideration, a modern destructor gives a cleaner emission from the chimney than does an ordinary steam plant. There is, however, always a certain amount of fine gritty dust about, and it is advisable to take precautions to prevent it from getting into the engine room. The practice of building the electricity works some distance away from the destructor is justified on this account, even though it may mean loss in the connecting steam pipe. Steam pipe lagging is comparatively cheap,

The further precaution of having tight windows and doors, and no open louvres, should be taken.

Building.—The interior of the building should be arranged, as far as possible, without pockets and corners where dust might lodge, and the walls should be covered with glazed brick, so that they may be washed down. Indeed, everything that is done for hospital buildings to make them sanitary should also be considered in designing the destructor house.

All Gases up Chimney.—To prevent the escape of any gases except by way of the chimney, the cubic capacity and general arrangement of the building should be such as to ensure the renewal of all the air in the building every 10 minutes or so. As a good deal of dust is given off when the stokers are clinkering, the fan draught pipes should be arranged to catch as much of this as possible. A dust catcher of ample size, easily accessible for clearing-out purposes, is necessary in the main flue between combustion chamber and boiler.

Heated Air Supply.—The air passing to the grate should have been previously heated to 300° or 400° F. in an air heater by the hot gases on the way to the chimney. Either steam jets or steam-driven fans may be used to give the draught. The latter is the most economical, and it produces the hard clinker suited for building purposes. A draught pressure of 6-in. water column in ashpit appears to be suitable for the thick fire of 18 in. which is necessary to get rid of the refuse expeditiously.

Thermal Storage.—The early difficulties with thermal storage as experienced at Shoreditch, owing to excessive vibration, &c., have been overcome. The idea is sound, both theoretically and practically, as shown in the various London electricity works, at Knightsbridge, St. Pancras, &c. Further, the extraordinary success of the thermal-storage system in connection with exhaust steam turbines working with intermittent exhaust from winding engines, &c., is evidence of the great advantages of the system.

Clinker.—The clinker is a real asset when the building trade is normal, and it should be taken full advantage of. When the clinker is drawn from the fire, it is first used to give additional heat to the air passing through the fresh charge above. It should be remembered in this connection that the clinker from ordinary slack coal fires has practically no value, although it gives nearly as much trouble to the stokers. A soft clinker is made with steam jets, and a hard clinker with fan draught. Allowing the material to be kept burning for some time after the maximum temperature has been attained makes it hard.

Uses of Clinker.—The clinker can be used for making artificial flag stones for paving, and concrete bricks, consisting of a 10 per cent. mixture of hydraulic lime and clinker, can be made at a cost of about 14s. per 1,000. The mortar mills and hydraulic machinery required to make up the clinker are, of course, driven by the steam raised by the destructor. The old tins, scrap iron, &c., can be disposed of to chemical works and scrap-iron merchants, and the fish refuse can be made into artificial guano.

Management.—To make a success of the combined station the refuse destructor should be under the electrical engineer. By combining the two, one office and staff is sufficient. A considerable saving of establishment charges may be made by combining the destructor and electricity works under one management. The office may be conveniently situated between the destructor and the power house. This, by the way, also applies to the chimney, which of course takes the hot gases from the destructor boiler on one side and the power house boilers on the other.

Stokers.—As hand stoking is absolutely necessary, and good management of the fire and draught makes all the difference between success and partial failure, the stokers should be picked men and the number of them sufficient, so that they are never pressed to get through their work.

One point in connection with the refuse destructor which boiler and steam engine makers should not be slow to appreciate is that it gives their manufactures an added lease of life. The internal-combustion engine and gas producers are making such rapid strides and show such good efficiency theoretically, if not practically, that anything which is favourable to the boiler and steam engine will have the full force of those interested in such manufactures in its favour.

NEW ELECTRICAL PROPOSALS FOR PARLIAMENT TO CONSIDER.

In the following we give, in our usual form, particulars of the electrical applications that have been lodged for the consideration of the Board of Trade and Parliament early next year. The full details have been given in the *London Gazette* during the last few weeks :—

(*a*) Electric Light and Power.

Accrington.—Corporation is applying for supply powers in Clayton-le-Moors urban district.

Acton District.—Metropolitan Electric Supply Co., Ltd., seeks powers to take over Acton U.D.C. electricity undertaking and powers.

Aldeburgh.—Messrs. Christy Bros. & Co., Ltd., Chelmsford, are applying for a prov. order for the borough.

Ashborne and District.—Ashborne Gas Co., Ltd., is to seek power to apply for electric lighting order.

Ashford.—East Kent Electric Supply Co., Ltd., seeks electric lighting powers for Eastwell, Kennington, Sevington, Willesborough, Great Chart, Hotfield and Kingsnorth.

Bermondsey.—Corporation is applying for extension of area of supply by including so much of the metropolitan borough of Bermondsey as is not included in the 1899 and 1902 Orders.

Blandford.—Messrs. J. & W. Purves, Exeter, are seeking a prov. order.

Bognor.—Prov. order for U.D.C.

Budleigh and Salterton.—Messrs. J. A. & W. T. Purves seek electric lighting powers.

Burry Port, Carmarthen.—U.D.C. is applying for a prov. order.

Carlisle.—Extension of Corporation electric lighting area so as to include portions of the rural district of Carlisle.

Chapel-en-le-Frith, Chinley and District Gas Co., Ltd., seeks power to apply for a prov. order to supply electricity.

Chepping Wycombe.—The W. (B.) E.L. and P. Co., Ltd., seeks powers to supply in Chepping Wycombe, West Wycombe, Chepping Wycombe Rural, and Hughenden.

Chichester.—The C. E.L. and P. Co., Ltd., seeks extensions of its supply limits, to include urban districts of Bognor and Littlehampton, and parts of Westhampnett, Westbourne and East Preston.

Cirencester.—Mr. J. H. Edwards, 127, Victoria Street, Bristol, seeks electricity supply powers.

Dorchester.—Messrs. J. and W. Purves are seeking a prov. order.

Gloucester.—Corporation. Exemption of generating station and refuse destructor from proceedings for nuisance. Powers are sought to let out electric motors on hire, and to supply electricity in bulk to neighbouring authorities.

Goole.—Application for prov. order by Mr. J. W. Speight, The Elms, St. Anne's-on-the-Sea.

Harrow and District.—The Harrow E.L. and P. Co., Ltd., seeks supply powers for Wealdstone and Pinner, and repeal or alteration of powers of North Metropolitan Electric Power Supply Co. in the said district and parish.

Leominster.—Mr. J. H. Edwards, Bristol, is seeking a prov. order.

Luton.—Corporation. Electric hiring and wiring, &c., powers.

Macclesfield.—New Electricity Co. of Macclesfield, Ltd., Bank Buildings, Kingsway, W.C., is applying for a prov. order.

Newcastle-upon-Tyne.—The Newcastle-upon-Tyne Electric Supply Co., Ltd., is applying for its powers to be extended so as to include the portion of Kenton that is within the city of Newcastle-on-Tyne.

Pateley Bridge.—Messrs. Christy Bros. & Co., Ltd., of Chelmsford, are applying for a prov. order.

Portishead and District.—Messrs. Christy Bros. & Co., Ltd., are seeking a prov. order.

Rhondda.—Application by U.D.C. for prov. order.

Rhondda.—U.D.C. seeks various powers, including construction of generating stations, agreements with Rhondda Tramways Co. *re* supply in bulk, provision of fittings, &c., and wiring of houses, &c. Confirmation of lease of generating station to Rhondda Tramways Co., Ltd.

St. Helens.—Various minor powers incidental to the electricity supply business are sought by the Corporation.

Salisbury.—Salisbury E.L. and Supply Co., Ltd., seek to supply in parts of the city not included in their order, also in Bemerton and West Harnham.

Sandwich, Deal, Walmer and District.—Application for prov. order by the Deal and Walmer Electricity Supply Co., Ltd., 36, Castle Street, Dover.

Sevenoaks.—Electric lighting powers applied for by U.D.C. ; power to take supply in bulk.

Sidmouth.—Sidmouth Gas Co., Ltd., seeks powers to dissolve itself and to form new company to supply gas and electricity for various purposes, including bulk supply. Erect electric generating station, &c.

Truro.—Messrs. J. & W. Purves are applying for a prov. order.

Uxbridge and District.—The Uxbridge and District E.S. Co., Ltd. (in liquidation) is applying for powers to transfer its rights, powers, &c., to Callender's Cable and Construction Co., Ltd.

Wimbledon.—The Corporation is seeking powers to supply electricity in the urban district of the Maldens and Coombe.

Winchester.—Corporation seeks further powers in relation to its acquisition of the undertaking of the Winchester E.L. and P. Co., Ltd.

Witney.—The U.D.C. is applying for a prov. order and for the transfer of the undertaking of the Witney Electric Supply Co., Ltd.

(*b*) Electric Traction.

Aberdare.—U.D.C. is seeking powers for tramways and railless traction.

Brighton District Tramways.—New company to acquire tramways between Hove and Shoreham-by-Sea, and construct additional lines in Brighton, Hove, Worthing, Portslade-by-Sea, Southwick and Shoreham-by-Sea, also Steyning West. Powers to apply for and take transfers of electric lighting orders, run trolley omnibuses, &c.

Brighton, Hove and District.—Brighton, Hove and Preston United Omnibus Co., Ltd., is applying for powers to construct and run a railless traction system in Brighton, Hove, Worthing, Portslade, New Shoreham, Southwick, Steyning West and Newhaven. Generating station.

Bristol.—B. Tramways and Carriage Co., Ltd., seeks powers for revival and extension of powers and extension of time.

Central London Railway.—Several new sections at Wood Lane. Running powers over portions of the G.W.R., &c.

Chiswick.—U.D.C. seeks powers to work omnibuses moved by electricity obtained from overhead conductors.

County of Hertford (Cheshunt).—Powers applied for by County Council, reviving the 1906 Light Railway Order, with amendments.

Croydon and Southern District Railless Electric Traction.—New company to run railless electric cars from Purley to Merstham, Beddington, Coulsdon, Warlingham and Caterham.

Dartford and District.—Tramway powers are sought by a company for the rural district.

Dewsbury.—Corporation. New tramway powers.

Gosport and Lee.—Light Railways Order applied for by the Portsmouth Street Tramways Co.

Great Northern Railway Co.—Seeks powers for the G.N. & City Railway to supply it with electricity.

Halesowen Light Railways (Extensions) (No. 2).—Application by Halesowen Light Railway Co.

Halifax.—Corporation is seeking powers for new tramways in Halifax and Brighouse, also in Luddenden Foot, Sowerby Bridge, Sowerby, Mytholmroyd, Queensbury, Shelf, Greetland, Stainland-with-Old Lindley, and Elland. Trackless trolley powers.

Kingston-upon-Hull.—Corporation new tramways; extension of generating station; bulk supply to Hedon, Hornsea, Withernsea, &c.

Kingston-upon-Thames.—Powers to Council to remove and relay tramways of the London United Tramways, Ltd., on Kingston-on-Thames Bridge. Contributions by London United Tramways to cost of widening.

Leagrave and Luton.—Light Railway Order application by G. Balfour and A. H. Beatty, 22A, College Hill, London, E.C.

Liverpool Overhead Railway.—Consolidation of loan capital and borrowing powers; power for Mersey Docks and Harbour Board to subscribe to or guarantee share or loan capital, &c.

London.—City Corporation. Powers to work electrically a tramway authorised by Foreign Cattle Market, Deptford, Act, 1898; agreements as to supply of electricity thereto, &c.

London.—Corporation (Bridges).—In the Bill for a new bridge over the Thames between Blackfriars and Southwark Bridges, powers are sought to alter the levels of L.C.C. tramways in Southwark Street.

London County Council (Tramways and Improvements).—Various new tramways. Extension of time for others already authorised.

London Electric Railway Co.—Various powers, including two sections, each about 4 furlongs, of railway, one in St. Martin's-in-the-Fields, between the eastern and western lines of the Charing Cross, Euston and Hampstead Railway at Charing Cross, the other at Paddington, connecting the Baker Street and Waterloo line with the G.W. Railway. Various powers as to agreements, &c.

London, Tilbury and Southend Railway.—Various powers, including "extension of powers for adapting and working railways by electrical power," application of powers therefor, also powers *re* erection of generating stations.

London United Tramways, Ltd.—Extension of time for completion of tramway No. 7 and acquisition of lands in Richmond.

Macclesfield and District Railless Electric Traction and Electricity Supply.—New company, for purposes indicated, in the borough of Macclesfield and urban district of Bollington.

Malvern.—New company seeks powers to run railless traction service in urban district and adjoining districts. Generating station.

Manchester.—Corporation. Extension of time for tramways; certain new tramway powers are also sought.

Matlock District.—New company seeks powers to run railless traction service in Matlock, Matlock Bath, Scarthin Nick and Cromford.

Metropolitan District Railway.—Purchase or lease by the M.D. Ry. and the London Electric Railway Companies, or Joint Committee thereof, of Lot's Road generating station, and of cable subways and other rights. Various other powers, including supply of energy "to any persons or companies for any purpose."

Metropolitan Electric Tramways.—Application by Metropolitan Electric Tramways, Ltd., for powers for a new bridge over the Lea in Tottenham and Walthamstow. New tramways in Walthamstow, Enfield, Hendon and Willesden. Extension of time.

Metropolitan Railway.—Widening of railway and construction of new station at or near Mount Pleasant; subway at Edgware Road station; agreements with tube railways, &c.

Middlesbrough, Stockton-on-Tees and Thornaby.—Imperial Tramways Co. is applying for extension of time for lines authorised in 1904 and 1907.

Morley.—Light Railway Order sought by the Corporation.

Newcastle-upon-Tyne.—Corporation seeks further tramway powers, trackless trolley cars. Agreements with local authorities as to electricity supply agreements with N. and District Electric Lighting Co., Ltd., acquisition and use of Lemington power station, &c.

Northampton.—Corporation is seeking powers for certain new tramways; power to use trackless trolley system.

Nottinghamshire and Derbyshire.—N. and D. Tramways Co. is applying for additional powers in respect of authorised tramways, extension of time, &c.

Oldham and Saddleworth District.—New company seeks powers to run railless electric traction system in Mossley, Waterside, Greenfield, Saddleworth, Tame Water Bridge, New Delph, &c. Power to Stalybridge, Hyde, Mossley and Dukinfield Tramways and Electricity Board to supply energy to the company.

Paignton.—The U.D.C. is applying for power providing that, in the event of the tramways authorised in 1909 not being completed and opened for traffic by the Torquay Tramways Co., Ltd., within the time limited by the Act of 1909, the powers be vested in and exercised by the Council.

Rotherham.—Corporation. Trackless trolley powers, new tramways, &c.

South Lancashire.—South Lancashire Tramways Co. is seeking powers for additional tramways in Little Hulton, Farnworth and Worsley; supply of energy, and consent of S. Lancashire Electric Power Co. thereto; numerous other provisions.

Southampton.—Corporation seeks further tramway powers.

Western Valleys (Monmouthshire).—New company to run railless electric traction system in Aberystruth, Brynmawr, Abertillery and Llanhilleth to Aberbeeg Junction, and to generate electricity therefor.

Widnes and Runcorn Bridge.—Transfer of undertaking to W. and R. Bridge Co.; generating-station powers.

Telegraph Construction.—Further powers to Postmaster-General as to construction and maintenance of telegraphic lines on railways and canals.

MEASUREMENT OF SELF-INDUCTANCE AND EFFECTIVE RESISTANCE AT HIGH FREQUENCIES.

BY CHAS. E. HAY, Engineer G.P.O.

To measure the effective resistance of inductive circuits at telephonic frequencies is difficult in cases where the inductance is large compared with the resistance, as in loading coils for telephone circuits. On this account, all the null methods known to the writer, which have been devised to measure self-inductance alone, are unsuitable, and especially so at frequencies of the order of 2,000 per second.

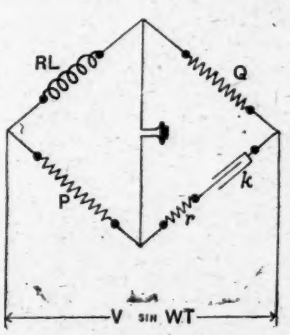


FIG. 1.

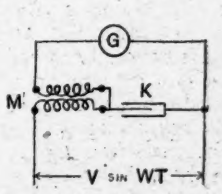


FIG. 2.

R, Effective resistance to be measured; L, Self-inductance to be measured; P Q, Non-inductive anti-capacity resistances (variable); *r*, Balancing resistance (variable); *k*, Balancing capacity (variable); *w*, π times the frequency of alternations.

The method described below, which has been devised by the writer and used by him with considerable success, does not appear to have been published before.

The apparatus is joined up in the form of a Wheatstone network, as shown in fig. 1, a telephone being used in place of a galvanometer. Any telephone will be found suitable,

but very good results have been obtained by means of a Sullivan wireless double-headgear telephone. The resistance (r) must be capable of very fine variations, and also the capacity (k); for the latter, mica and air-condensers are necessary. It is also very important that the insulation of the different apparatus and the wiring should be very high, and, in order that the capacity to earth of the leads to the source of E.M.F. and the generator should not affect the test, it is best to take the current to the network from the secondary of a transformer which has its windings highly insulated from each other. Means should also be adopted to avoid capacity between the primary and secondary windings.

Assuming a sinusoidal E.M.F., for balance,

$$[\mathrm{P\,Q} - (\mathrm{R} + \mathrm{L}\,\theta)\ (r + 1/k\,\theta)]\ \mathrm{v} \sin wt = 0,$$

where θ is d/dt.

$$\therefore [\mathrm{R} + \theta\ (k\,r\,\mathrm{R} + \mathrm{L} - \mathrm{P\,Q}\,k) + \theta^2\,\mathrm{L}\,k\,r]\ \mathrm{v} \sin wt = 0,$$

$$\therefore [(\mathrm{R} - \mathrm{L}\,k\,r\,w^2) + (k\,r\,\mathrm{R} + \mathrm{L} - \mathrm{P\,Q}\,k)^2\,w^2]\ \mathrm{v} \sin wt = 0.$$

From which

$$\mathrm{R} = \mathrm{L}\,k\,r w^2.$$

$$\mathrm{R/L} = k\,r\,w^2 \quad \ldots \quad \ldots \quad \ldots \quad \ldots (1)$$

$$\mathrm{L} = \mathrm{P\,Q}\ \frac{k}{k^2\,r^2\,w^2 + 1} \quad \ldots \quad \ldots \quad \ldots (2)$$

$$\mathrm{R} = \mathrm{P\,Q}\ \frac{k^2\,r\,w^2}{k^2\,r^2\,w^2 + 1} \quad \ldots \quad \ldots \quad \ldots (3)$$

Since these expressions contain w, the E.M.F. must be sinusoidal, and the frequency accurately known. The generator in the laboratory of the Engineer-in-Chief's department, G.P.O., gives an E.M.F. which approximates very closely to the sine form, and its frequency can be easily measured to a high degree of accuracy by mechanical means. In any case, at the moment of making a test the actual frequency can be determined electrically as follows:—

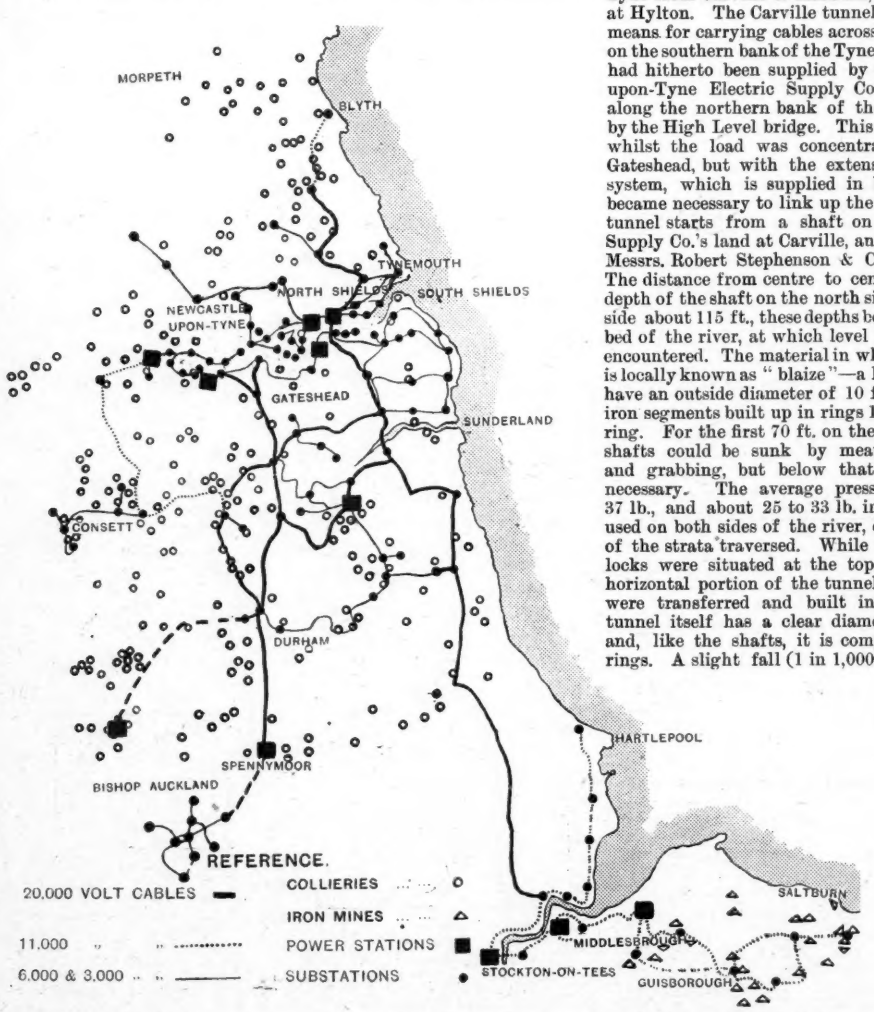
A variable mutual inductance and a highly-insulated condenser of one microfarad are joined up to a sensitive thermo-galvanometer, as in fig. 2. For the frequencies met with in telephonic work a condenser of one microfarad and a small range of low mutual inductance only are necessary.

For no current through the galvanometer—

$$w^2\,\mathrm{M\,K} = 1.$$

The method is particularly valuable for measuring the effective resistance and self-inductance of loading coils used for telephone purposes. Its usefulness is, however, not confined to this, as it appears to have great sensitivity over a very large range.

It will be observed that the ratio R/L, which is required in connection with the loading of telephone cables, is very easily obtained by the method, being simply equal to $k\,r\,w^2$.



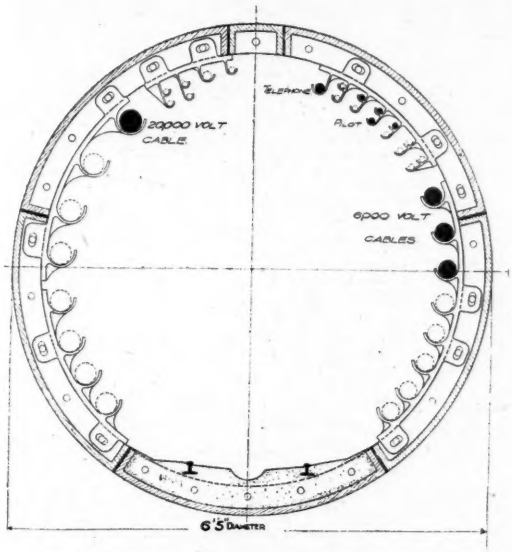
The Electrical Distribution Systems of the Newcastle-upon-Tyne Electric Supply and Associated Companies.

THE CABLE TUNNELS UNDER THE RIVERS TYNE AND WEAR.

In connection with the distribution of electrical power on the north-east coast, two cable tunnels of an interesting design have for some time been in commercial use by the Newcastle-upon-Tyne Electric Supply Co. and the County of Durham Electrical Power Distribution Co. One of these has been carried under the river Tyne from Carville to Hebburn, and the other under the River Wear at Hylton. The Carville tunnel was undertaken in order to provide means for carrying cables across the river to meet the growing load on the southern bank of the Tyne and in the county of Durham, which had hitherto been supplied by cables running from the Newcastle-upon-Tyne Electric Supply Co.'s generating station at Carville along the northern bank of the river and thence across the Tyne by the High Level bridge. This method afforded an adequate supply whilst the load was concentrated in and around the district of Gateshead, but with the extension of the County of Durham Co.'s system, which is supplied in bulk from the Carville station, it became necessary to link up the areas by a more direct route. The tunnel starts from a shaft on the Newcastle-upon-Tyne Electric Supply Co.'s land at Carville, and terminates in a similar shaft in Messrs. Robert Stephenson & Co.'s shipbuilding yard at Hebburn. The distance from centre to centre of the shafts is 977 ft., and the depth of the shaft on the north side is about 120 ft., and on the south side about 115 ft., these depths being approximately 70 ft. below the bed of the river, at which level a suitable stratum for driving was encountered. The material in which the tunnel was driven was what is locally known as "blaize"—a kind of dark blue shale. The shafts have an outside diameter of 10 ft., and they are composed of cast-iron segments built up in rings 18 in. deep, with six segments to the ring. For the first 70 ft. on the Carville side it was found that the shafts could be sunk by means of superimposed weights and and grabbing, but below that depth compressed air work was necessary. The average pressure in the shafts was from 35 to 37 lb., and about 25 to 33 lb. in the tunnel. Compressed air was used on both sides of the river, owing to the water-bearing nature of the strata traversed. While the shafts were in progress the air locks were situated at the top of each shaft, but, as soon as the horizontal portion of the tunnel was carried sufficiently far, they were transferred and built into the horizontal position. The tunnel itself has a clear diameter inside the flanges of 5 ft. 8 in., and, like the shafts, it is composed of cast-iron segments built in rings. A slight fall (1 in 1,000) has been given to the tunnel for the purpose of drainage towards the north side, where an electrically-driven pump is situated, which is automatically operated by a float. Access to the tunnel is provided by ladders and landings down each shaft. Three-core, lead-covered and wire-armoured cables for carrying current at 20,000 volts and 6,000 volts, with pilot cables in addition, are carried on racks bolted at intervals to the segments in the tunnel. Provision has been made for 16 E.H.T. cables, eight for 20,000 and eight for 6,000 volts, and there are 16 pilot cables for protected switchgear and two telephone cables. The cables were provided and erected by Messrs. Callender's Cable & Construction Co., Ltd.

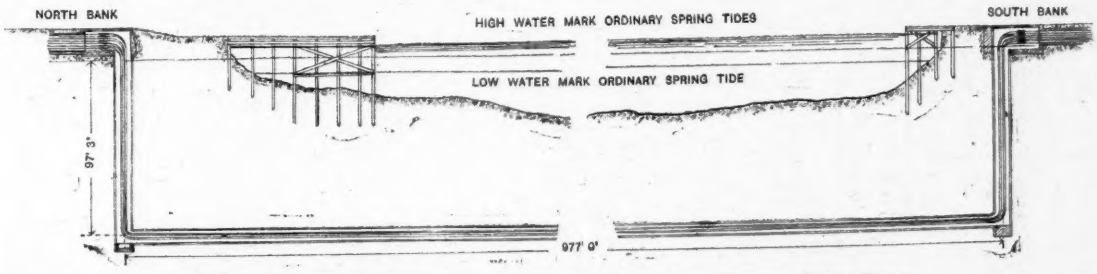
The construction of the Wear tunnel was rendered necessary, owing to the development of the cable systems of the County of

Durham Electrical Power Distribution Co. and the Cleveland and Durham Electric Power, Ltd. It had been originally intended that this tunnel should be built in the same way as the one under the River Tyne, but of smaller dimensions. The shafts were to have been 4 ft. 6 in. clear internal diameter, and the horizontal portion of the tunnel 3 ft. 6 in. clear internal diameter, the linings in each case being composed of cast-iron built-up segments. The site selected for the Wear tunnel was immediately above the village of Hylton, four miles distant from Sunderland, and at a point where the river is 215 ft. wide and 20 ft. deep at high water. With the view, however, of securing a suitable location for a sub-station on the south side, and of the existing roads on either bank, it was found necessary to set the shafts on both the north and south sides of the river some distance back from the water's edge, so that, as constructed, the total horizontal length of the tunnel is



Cross Section Through Cable Tunnel under the River Tyne.

370 ft. Sinking was commenced from the south side, and the lining was built up and forced down by superimposed weight until a firm material was reached, after which excavation was resorted to in the ordinary way. On reaching the predetermined depth, it was found that the material was a species of rock sufficiently firm to make possible a concrete construction. It was, therefore, decided to abandon the original circular cast-iron section and to build the tunnel in concrete of oval section. This formation was adhered to for a horizontal distance of 180 ft., when it was found that the material was gradually becoming softer, and ultimately ended in running sand. Thereupon a shield was employed to build a portion of the tunnel which traverses the sand, and segments, the same size as those used in the Tyne tunnel, namely, 6 ft. diameter, were employed for this portion of the work. A similar procedure was adopted in driving from the north side. The off-set at the bottom of the shaft was made, as before, in concrete and the tunnel driven and lined in concrete for a distance of 120 ft., after which the iron construction was resorted to, the tunnel having again penetrated into sand. The work in sand was extremely slow and was further complicated by a blow-out occurring in the bed of the river, necessitating the suspension of tunnelling operations until a blanket of clay had been dumped in barges over the line of tunnel construction. Compressed-air work was employed throughout the whole length of the horizontal portion of the tunnel. After the final work of caulking and grouting, it was found that the tunnel was fairly watertight, and the jointing of the power cables at the top of the shaft was effected in manholes constructed for the purpose. On the south side of the Wear tunnel the shaft outlet adjoins a sub-station at which current is transformed for use in the shipbuilding yards and other industries in the locality. The work of constructing these two cable tunnels was carried out by Messrs. Robert McAlpine & Sons, of Glasgow, to the designs and under the supervision of Messrs. Merz & McLellan, the consulting engineers to the electric supply companies.



Section Showing Position of Cable Tunnel and Access Shafts, River Tyne.

FOREIGN AND COLONIAL TARIFFS ON ELECTRICAL GOODS.

Amendments.

AUSTRALIAN COMMONWEALTH.—The Australian Customs authorities have issued the following decisions as to duties on imported goods. The rates given are those under the preferential tariff applicable to British goods :—

Electrical Appliances, &c.—

Collars for telephone receivers, imported separately (these are small pieces of tubing about ¼ in. long, for use with terminal screws) :
- If plated or mixed metalware... ... ... 20 %
- Otherwise ... ... 25 %

Conduit, electric, fittings for, viz. :
- Armoured insulated split tee pieces ... ...
- " " inspection tee pieces... ...
- " " split crosses or four-way pieces
- " " circular two-way inspection boxes
} 10 %

Saddles, clips and crampets ... ... 25 %

Interiors, porcelain (porcelain and metal), for use with "Perfecta" boxes ... ... 10 %

Lamps, &c. :
- Lantern (electric), The Aston "Radiant," with or without incandescent lamp ... ... 10 %
- "Streetlites" electric lamp (similar to Aston "Radiant" lantern referred to above) ... ... 10 %
- Testing lamp (a small electric lamp for immersing in acid for purpose of testing) ... ... 10 %

Magneto (wipe spark), Vim, with friction pulley and governor ... ... Free.

Sparker, auto, for gas and gasolene engines (being a small dynamo but not a magneto) ... ... 20 %

Vibrator, Barker's portable electric. This comprises, in some forms, a separate motor which drives the vibrating portion, like a dental engine is worked ; in other forms the motor and vibrating portion are built into the same holder :
- Having detachable motor :
  - Motor ... ... 20 %
  - Balance ... ... 20 %
- Having motor and vibrator built into one case ... 20 %

Wheels, pinion, magneto, on shaft or otherwise, being power connections ... ... 20 %

Screws for terminals of telephone receivers which fit into the "collars for telephone receivers" referred to above... Free.

Signalling apparatus, electric, railway, "Tyer's one-wire three position ; with lightning arrester built into the cabinet... ... ... 10 %

Note.—The value on which duty is calculated is the fair market value of the goods in the principal markets of the country whence the same were exported in the usual and ordinary commercial acceptation of the term "free on board" at the port of export in such country, with a further addition of 10 per cent. on such market value.

Calcium Carbide in 1909.—Statistics are given in the *Revue des Eclairages* for October 30th of the world's production and consumption of calcium carbide in 1909. The principal producing countries are the following : Norway and Sweden (50,000 tons) ; United States (45,000) ; Switzerland (30,000) ; Italy (29,000) ; France (28,000) ; Austria-Hungary (20,000) ; Spain and Portugal (18,000) ; Canada (10,000) ; Germany (9,000) ; and Great Britain (2,000). The consumption is distributed in a very different order, as follows : Germany (34,884 tons) ; United States (32,000) ; France (25,000) ; Italy (24,000) ; Austria-Hungary (17,000) ; Spain and Portugal (16,000) ; Great Britain (14,000) ; Australia (10,000) ; Canada (8,000) ; Argentina (7,000) ; Brazil (6,500) ; Switzerland (6,000) ; Norway and Sweden (5,500) ; Belgium (5,500) ; and a large number of countries taking smaller quantities. Although large producers, Germany has to import over 25,000 tons, and Italy 1,000, while this country imports 12,000 tons.

NEW PATENTS APPLIED FOR, 1910.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by MESSRS. W. P. THOMPSON & Co., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford, to whom all inquiries should be addressed.

26,984. "Improvements in single-phase alternating-current motors." B. PARKER-HAIGH. November 21st.

27,026. "Improvements in automatic telephone circuits." SIEMENS AND HALSKE AKT.-GES. (Date applied for under Sec. 91 of the Act, November 20th, 1909, being date of application in Germany.) November 21st. (Complete.)

27,037. "Improvements in electric regulators and the like." H. LEITNER. November 21st.

27,060. "Improvements relating to the rectification of alternating electric currents and to devices for use therein." ELEKTROMECHANISCHE WERKE G.M.B.H. (Date applied for under Sec. 91 of the Act, November 22nd, 1909, being date of application in Germany.) November 18th. (Complete.)

27,096. "Improved attachment for shades for electric glow lamps." G. DAVIS. November 22nd.

27,100. "Improved method of electrical and mechanical advertising." J. H. SPREE. November 22nd.

27,116. "Improvements in the generation or production of electricity and in means or apparatus for utilising the same for driving and other purposes." A. G. SANDERSON. November 22nd.

27,119. "Improvements in or relating to methods of starting electrical induction motors." G. H. FLETCHER and E. A. GATEHOUSE. November 22nd.

27,144. "Improvements in or relating to submarine telegraphy and signalling." E. KLUPATHY and C. BERGER. (Date applied for under Sec. 91 of the Act, June 30th, 1910, being date of application in Hungary.) November 22nd. (Complete.)

27,155. "Improvements in and relating to electrical ignition apparatus particularly applicable for internal combustion engines." F. L. HOLLISTER and C. A. VANDERVELL. November 22nd.

27,162. "Improvements in or connected with carbon brushes for dynamo-electric machines." S. BEETON and MORGAN CRUCIBLE CO., LTD. November 22nd.

27,163. "Improvements in electric vapour lamps." K. RITZMANN, M. WOLFKE and F. LISSY. November 22nd. (Complete.)

27,168. "Improvements relating to ignition machines for internal combustion engines." Firm of ROBERT BOSCH. (Date applied for under Sec. 91 of the Act, October 29th, 1910, being date of application in Germany.) November 22nd. (Complete.)

27,174. "Improved suspension chain for high pressure electric transmission wires." Soc. VEDOVELLI PRIESTLEY ET CIE. (Date applied for under Sec. 91 of the Act, April 5th, 1910, being date of application in France.) November 22nd. (Complete.)

27,176. "Improvements in and relating to the manufacture of electric accumulator plates." J. APOZNANSKI. November 22nd. (Complete.)

27,199. "Improvements in the manufacture and construction of electrical batten lampholders." S. HEATH & SONS, LTD., C. H. HARRISON and G. H. LINES. November 23rd.

27,205. "Improvements in the means of carrying brushes for electric machines and holding them up to their work and in their electrical connections." ELECTRIC CONSTRUCTION CO., LTD., and N. PENSABENE. November 23rd.

27,223. "Improved apparatus for causing electrical impulses for transmission to a distance." J. A. GARDNER and A. FERGUSON. November 23rd. (Complete.)

27,240. "Improved incandescent electric lamp." R. BACCI. November 23rd. (Complete.)

27,248. "Switch plug box." J. KALAMBA. (Date applied for under Sec. 91 of the Act, March 7th, 1909, being date of application in Germany.) November 23rd. (Complete.)

27,256. "Improvements in or connected with the ignition apparatus of motor vehicles and the like." G. FORSTER. November 23rd.

27,259. "Improvements in electrical safety fuses." G. MULLER. November 23rd. (Complete.)

27,261. "Improvements in and in the manufacture of electrodes for secondary batteries or storage cells." V. DE KARAVODINE. November 23rd.

27,464. "Improvements in apparatus for the purification of electrolytic gases." A. E. KNOWLES. November 23rd.

27,265. "Improvements in variable-speed dynamos." H. LEITNER. November 23rd.

27,277. "Improved thermally actuated electric switch." W. K.-L. DICKSON. November 23rd.

27,293. "Improvements in electrically driven clocks and other running mechanism." R. M. LOWNE and LOWNE ELECTRIC CLOCK AND APPLIANCES CO., LTD. November 23rd.

27,299. "Improvements relating to electric hoists or pulley blocks, winches and the like." ADAMSON RAMSBOTTOM & CO., LTD., and H. RAMSBOTTOM. November 23rd.

27,312. "Improvements in methods of clearing faults in alternating current high-tension system." A. M. TAYLOR. November 24th.

27,395. "Improvements in systems of transmission." H. LEITNER. November 24th.

27,396. "Improvements in systems of train lighting and the like." H. LEITNER. November 24th.

27,401. "Improvements in and relating to incandescent electric lamps." S. HORVATH. November 24th.

27,415. "Improved electric arc lamp." J. W. Mackenzie. (Société Anonyme Banque du Radium, France. November 24th. (Complete.)

27,419. "Improvements in brush-holders for dynamo-electric machines." J. L. MANUFACTURING CO., LTD., and T. L. R. COOPER. November 25th.

27,431. "Improvements in cooking and heating apparatus heated by electricity or otherwise." J. A. ABBOTT. November 25th.

27,448. "Improved device for carrying electric cables, conduits, rods, or the like." J. A. ROBERTSON. November 25th. (Complete.)

27,460. "Improvements in the control of direct-current electric motors." SIEMENS BROS. DYNAMO WORKS, LTD., M. KLOSS and E. SCHUPP. November 25th.

27,495. "Improvements in or relating to electric incandescent lamps." F. H. PURCHAS. November 25th. (Complete.)

27,530. "Improved electric foot battery or sock." W. HART and H. J. WEST. November 26th.

27,536. "Improvements in fusible cut-outs for controlling electric circuits." V. HOPE. November 26th.

27,557. "Improvements in and relating to non-sparking electrical contacts." L. G. F. FOKES. November 26th.

27,574. "Improvements in sparking plugs." E. KUHN. (Date applied for under Rule 13th, May 17th, 1910. An invention comprised in Application No. 12,133, dated May 17th, 1910.) November 26th. (Complete.)

PUBLISHED SPECIFICATIONS.

Copies of any of the Specifications in the following list may be obtained of MESSRS. W. P. THOMPSON & Co., 285, High Holborn, W.C., and at Liverpool and Bradford; price, post free, 9d. (in stamps).

1909

APPARATUS FOR ELECTRICALLY OPERATING PLANING MACHINES AND THE LIKE RECIPROCATING TOOLS. Lancashire Dynamo and Motor Co. and G. E. Mason. 22,234. September 30th.

DEVICES FOR AUTOMATICALLY CONTROLLING ELECTRIC CIRCUITS. J. G. Royce and H. G. Sharp. 25,040. November 30th.

CONSTRUCTION AND MANUFACTURE OF CONDENSERS AND ARTIFICIAL LINE FOR USE IN "DUPLEX" TELEGRAPHY. A. Muirhead and Muirhead & Co. 25,013. November 1st.

METHOD OF AND APPARATUS FOR HEATING WATER BY ELECTRICITY. C. Kratt. 25,296. November 3rd.

ELECTRIC ARC LAMPS. L. C. H. Mensing. 25,373. November 3rd. (Application for Patent of Addition to No. 3,243 of 1904.)

INDUCTIVE WIRELESS TELEPHONE SYSTEMS. H. von Kramer. 25,407. November 4th.

MEANS FOR EFFECTING TELEPHONIC COMMUNICATION WITHOUT CONNECTING WIRES. A. G. Matthews. 25,639. November 6th. (Cognate application, No. 13,229 of 1910.)

EXHAUSTION OF METALLIC-FILAMENT LAMPS. H. Kuzel. 25,889. November 9th. (Date applied for under International Convention, December 21st, 1908.)

ELECTRIC SELECTIVE DEVICES ESPECIALLY APPLICABLE TO TELEPHONE SYSTEMS AND THE LIKE. American Automatic Telephone Co. and C. L. Goodrum. 25,896. November 9th.

ELECTRIC AND ELECTRO-PNEUMATIC ORGANS. S. G. Metzger and R. Smith. 25,932. November 10th.

ELECTRIC IRONS. J. Smith, H. L. Mitchell, and W. H. Askham and H. Hey. 27,816. November 19th.

CONTROLLERS FOR ELECTRIC MOTORS. Electric Construction Co. and F. W. Close. 29,200. November 14th.

ELECTRIC TIME-SWITCHES. P. Schröder. 30,216. December 4th.

1910.

TELEGRAPHIC AND TELEPHONIC TRANSMISSION OF PICTURES. N. Montagna. 15,734. May 25th. (Date applied for under International Convention, November 6th, 1909.)

DYNAMO-ELECTRIC MACHINES. Allgemeine Elektricitäts Ges. 15,753. May 25th. (Date applied for under International Convention, July 1st, 1909.)

METHOD OF WORKING ARC LAMPS IN SERIES WITH INCANDESCENT LAMPS. A. Heimann and W. Schaffer. 747. January 11th. (Date applied for under International Convention, January 13th, 1909.)

CONTACTS FOR ELECTRIC LAMP HOLDERS AND LAMPS. Siemens Bros. & Co. and J. S. Huddlestone. 1,597. January 21st.

MICROPHONES. G. A. Nussbaum. 3,179. February 9th.

DYNAMOS FOR LIGHTING AND OTHER PURPOSES. J. de Coster. 4,758. February 25th.

APPARATUS FOR PRODUCING HIGH-FREQUENCY OSCILLATORY CURRENTS. F. Jacoviello. 7,184. March 22nd.

MAGNETIC CLUTCH. L. Dutheil, R. Chalmers & Co. 8,294. April 6th. (Date applied for under International Convention, April 6th, 1909.)

ELECTRIC HEATING APPARATUS. M. Lofquist. 10,097. April 25th.

REINFORCED CONCRETE TELEGRAPH POLES AND THE LIKE. Esparza. 10,676. April 30th. (Rights under Sec. 91 of the Act not granted.)

SEARCHLIGHT APPARATUS. Siemens-Schuckertwerke Ges. 11,054. May 4th. (Date applied for under International Convention, May 10th, 1909.)

BINDING SCREWS OR TERMINALS FOR ELECTRICAL PURPOSES. Evershed and Vignoles, Ltd., S. Evershed and Payne. 11,277. May 6th.

ACTUATION OF CONTROLLERS FOR ELECTRIC MACHINERY PARTICULARLY APPLICABLE TO ELECTRIC TRACTION. H. B. van Daalen. 11,437. May 9th. (Application for Patent of Addition to No. 15,208 of 1909.)

METHOD OF WORKING ARC LAMPS AND INCANDESCENT LAMPS IN COMMON ON AN ALTERNATING-CURRENT CIRCUIT. A. Heimann and W. Schaffer. 11,583. May 10th. (Date applied for under International Convention, January 10th, 1910. Application for Patent of Addition to No. 748 of 1910.)

SPARKING-PLUGS FOR INTERNAL-COMBUSTION ENGINES. B. Brooks and F. H. Alston. 12,820. May 25th.

MOVABLE COIL ALTERNATING-CURRENT TRANSFORMERS FOR SUPPLYING CURRENTS OF CONSTANT VALUE. Siemens Bros. Dynamo Works (Siemens-Schuckertwerke Ges.) 13,015. May 28th.

ELECTRIC ROTARY TRANSFORMERS. R. Hoskins. 15,938. July 4th.

STARTING ARRANGEMENTS FOR SINGLE-PHASE ALTERNATING-CURRENT SERIES MOTORS. Siemens Bros. Dynamo Works. (Siemens-Schuckertwerke Ges.) 18,848. August 10th.

Limiting Voltages on Transmission Lines.—In the *Electrical World* of November 17th, Mr. Erich Hausmann discusses the limit imposed upon transmission at very high pressures by the breakdown of the air round the conductors, rendered apparent by the formation of a corona. The pressure at which this takes place is given by the formula—

$$E_m = F\, r \log_\epsilon d/2r \text{ kilovolts,}$$

where E_m is the maximum value of the voltage on a representative single-wire circuit with earth return (or voltage to neutral), F is the maximum electric strength of air at the conductor surface in kilovolts per inch, r is the radius of the conductor in inches, and d is the interaxial distance between the wires in inches. The value of F for smooth cylindrical conductors from 0·05 to 0·50 in. in diameter is given by—

$$F = 95{\cdot}5\,(2r)^{-\frac{1}{2}} \text{ kilovolts per inch}$$

at 20° C. and 760 mm. pressure. From these equations the limiting value of the voltage may be written—

$$E_m = 110\,(2r)^{0{\cdot}8} \log_{10} d/2r \text{ kilovolts.}$$

It should be noted, however, that F may be lowered by the presence of surface impurities on the wire, and is influenced by changes of temperature and pressure.